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Jane's Explosive Ordnance Disposal 2009-2010

Colin King

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Jane's Explosive Ordnance Disposal 2009-2010

Colin King

Ninth Edition

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How to use

Contents

This reference work deals with two distinct categories of information. The first, consisting of three sections (*Background information*, *Identification* and *Types of unexploded ordnance*), deals with the technical aspects of EOD. Additional information on specific weapons is provided in production and data summary tables. These sections, updated and edited by Colin King, focus on providing information for use at the operational level, or for understanding the major issues relating to field operations.

The second category, which is updated by staff at Jane's, deals with the market surrounding EOD. This aims to provide comprehensive coverage of the equipment and services available, with a section devoted to each.

Structure

Background Information

This section is intended to provide basic technical reference material. The entries on explosives detail the characteristics and properties of common types while explaining the difference between 'primary' and 'secondary' High Explosives (HE); the characteristics of both solid and liquid propellants are also explained.

The Background information section also introduces the major types of equipment used in both conventional EOD and Improvised Explosive Device Disposal (IEDD). A contents list is provided at the beginning of the Background information section.

Identification

Correct identification is fundamental to an accurate threat assessment and to the selection of an appropriate Render Safe Procedure (RSP). The reference material on colour codes and markings provided in the Identification section is applicable across a range of munitions; these can reveal vital information about a weapon's characteristics, including its type, intended role, specifications, explosive filling and primary hazards.

Further identification aids relating to particular ammunition categories are listed in Section 3 (Types of unexploded ordnance), along with the detailed entries covering the various munitions. Several entries on explosives allow cross-referencing between the dozens of national nomenclatures and designators in common use, listing the countries of origin and constituents of military, commercial and home-made explosives and propellants. A contents list is also provided at the beginning of the Identification section.

Types of unexploded ordnance

There are thousands of types of munition, making it impossible to catalogue each one. This section divides munitions, in alphabetical order, into the basic categories (mines, missiles, mortar bombs and so on) and then further subdivides them into groups with similar functions or characteristics. Most entries include a generic description of the munition type and how it functions, while some entries focus on typical examples. Where possible, specifications, photographs or diagrams are included for several examples to illustrate variations within the group. Most entries also have a list of 'EOD considerations'; these are not RSPs but instead are intended to prompt the technician or warn of specific hazards. In addition to the general guide in Section 2, identification information related to specific munition types (such as lists of designators along with brief descriptions) is included here. Tables listing production by country for some of the weapon categories are included in the Data summary (Section 6).

Equipment

This section aims to provide the best possible coverage of the equipment commercially available to EOD organisations. For ease of reference, equipment is grouped under appropriate subsections (such as detection equipment, EOD weapons and remote control vehicles) and then is listed in alphabetical order by country of origin. A list of the subsections is given at the beginning of the section. Where possible, each entry has a picture and an objective description of the item and the function for which it was designed. Basic specifications are provided, along with the name of the manufacturer. Contact details are collated in a separate section.

Services

This section provides details of the various organisations involved in, supporting or related to EOD. As in the previous section, entries are grouped under subsections and are catalogued in alphabetical order by country, with contact details listed separately. The diverse categories (listed at the beginning of the section) include agents for equipment, consultants, information resources, research and development agencies and training establishments.

Data Summary

The Data summary contains tables outlining national inventories and production of weapons. The Inventories table lists, country by country, the munition types of greatest EOD interest believed to be held in national inventories. It is intended to assist organisations planning for operational or training deployments and to aid recognition. The Production tables list the designations and specifications of many munition types and also contain images of many weapons.

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Glossary

The following are standard abbreviations in common use. Abbreviations for explosives are also listed in the *Identification* section.

AA	Anti-Aircraft or Air-to-Air
AAM	Air-to-Air Missile
AD	Anti-Disturbance or Air Defence
ADAM	Area Denial Artillery Munition
AGL	Automatic Grenade Launcher
AHD	Anti-Handling Device
AHM	Anti-Helicopter Mine
AIM	Air Intercept Missile (USA)
Al	Aluminium
AN	Ammonium Nitrate
AP	Armour-Piercing or Anti-Personnel (mines)
APAM	Anti-Personnel Anti-Matériel
APDS	Armour-Piercing Discarding Sabot
APERS	Anti-PERSonnel
APFSDS	Armour-Piercing Fin-Stabilised Discarding Sabot
APHE	Armour-Piercing High Explosive
APHEI	Armour-Piercing High-Explosive Incendiary
API	Armour-Piercing Incendiary
APSE	Armour-Piercing Special Effect or Armour-Piercing Secondary Effect
AS	Air-to-Surface
ASM	Air-to-Surface Missile
AT	Anti-Tank
ATGM	Anti-Tank Guided Missile
ATGW	Anti-Tank Guided Weapon
ATSC	Anti-Tank Shaped Charge (a type of mine)
AWA	All Ways Acting (relating to fuzes)
BAC	Battle Area Clearance
BAT	Brilliant Anti-armour Technology
BB	Base Bleed or Base Burn
BBU	Base Bleed Unit
BD	Base Detonating (relating to fuzes)
BE	Base Ejection
BF	Base Fuzed
BLU	Bomb Live Unit (USA)
BP	Black Powder
CBU	Cluster Bomb Unit (USA)
CCC	Combustible Cartridge Case
CCM	Convention on Cluster Munitions
CCTV	Closed Circuit TeleVision
CE	Composition Exploding (old term for Tetryl high explosive)
CS	A common lachrymatory agent ('tear gas')
CTS	Counter-Terrorist Search
CWC	Chemical Weapons Convention
DB	Double Base (for example, propellant)
DEODS	(British) Defence EOD School
DIME	Dense Inert Metal Explosive
DP	Dual Purpose
DPICM	Dual-Purpose Improved Conventional Munition
DS	Discarding Sabot
DU	Depleted Uranium
EDB	Extruded Double Base (propellant)
EFF	Explosively Formed Fragment
EFP	Explosively Formed Projectile (from an MS warhead)
EGDN	EthyleneGlycol DiNitrate
EOC	Explosive Ordnance Clearance
EOD	Explosive Ordnance Disposal
EOR	Explosive Ordnance Reconnaissance
ER	Extended Range or Enhanced Radiation
ERA	Extended-Range Ammunition or Explosive Reactive Armour
ERP	Extended-Range Projectile
ETF	Electronic Time Fuze
FAE	Fuel-Air Explosive
FASCAM	FAmily of SCAtterable Mines
FLIR	Forward-Looking Infra-Red
FLM	Focussed Lethality Munition
FOG	Fibre-Optic Guided
Frag	Fragmentation
FS	Fin-Stabilised
FSDS	Fin-Stabilised Discarding Sabot
FWAM	Full-Width Attack Mine
g	Gram
GAU	Gun Aircraft Unit (USA)
GBU	Glide Bomb Unit (USA)
GP	General Purpose or Gun Powder
GPS	Global Positioning System
h	Hour
HB	Hollow Base
HC	Hard Core or High-Capacity
HD	High Drag (bomb)
HE	High Explosive
HEAD	High Explosive Air Defence
HEAP	High Explosive Anti-Personnel
HE/AP	High Explosive Armour-Piercing
HEAT	High Explosive Anti-Tank
HEDP	High Explosive Dual Purpose
HEER	High Explosive Extended Range
HEI	High Explosive Incendiary
HEISAP	High Explosive Incendiary Semi-Armour-Piercing
HE-I-T	High Explosive, Incendiary, Tracer
HEP	High Explosive Plastic (US term for HESH)
HESH	High Explosive Squash Head
HMX	High Melting eXplosive (high explosive)
HP	Hollow Point or High Pressure
HTBF	Hard Target Bomb Fuze
HTP	High-Test Peroxide (liquid propellant)
HTPB	Hydroxy-Terminated Polybutadiene Binder
HV	High-Velocity
HVAP	High-Velocity Armour-Piercing
HVAPFSDS	High-Velocity Armour-Piercing Fin-Stabilised Discarding Sabot
ICM	Improved Conventional Munition
ICP	Incident Control Point
IED	Improvised Explosive Device
IEDD	Improvised Explosive Device Disposal
IIR	Imaging Infra-Red
ILL	ILLuminating
IM	Insensitive Munition
INS	Inertial Navigation System
IPN	IsoPropylNitrate
IR	Infra-Red
IRFNA	Inhibited Red Fuming Nitric Acid
KE	Kinetic Energy
kg	Kilogram
kJ	Kilojoule
kT	Kiloton
LAW	Light Anti-tank Weapon
LD	Low Drag (bomb)
LED	Light-Emitting Diode
LCDB	Low Collateral Damage Bomb
LGB	Laser-Guided Bomb
LGP	Laser-Guided Projectile
LRBB	Long-Range Base Bleed
LRHB	Long-Range Hollow Base

LV	Low velocity
m	Metre
MAC	Metal Augmented Charge (enhanced blast)
MANPADS	MAN-Portable Air Defence System
MCLOS	Manual Command to Line Of Sight (missile guidance)
MFBF	Multi-Function Bomb Fuze
min	Minute
MLRS	Multiple-Launch Rocket System
mm	Millimetre
MMW	MilliMetric Wave
MRF	Multi-Role Fuze
MRL	Multiple Rocket Launcher or Modular Rocket Launcher
MS	Misznay Schardin (a warhead design that produces an Explosively Formed Projectile (EFP) or self-forging fragment)
m/s	Metres per second
MT	Mechanical Time
MTSQ	Mechanical Time and Super-Quick
MV	Muzzle Velocity or Medium Velocity (grenades)
n/a	Not available
n/k	Not known
NATO	North Atlantic Treaty Organisation
NB	NitroBenzine
NBC	Nuclear, Biological and Chemical
NC	NitroCellulose (high explosive used in propellants)
NE	Nose Ejection
NEQ	Net Explosive Quantity
NF	Nose Fuzed
NG	NitroGlycerine (high explosive used in propellants)
PBX	Polymer-Bonded eXplosive (high explosive)
PD	Point Detonating
PE	Plastic Explosive
PETN	PentaErythritol TetraNitrate (high explosive)
PGM	Precision-Guided Munition
PGSM	Precision-Guided SubMunition
PIBD	Point Initiating Base Detonating
PPE	Personal Protective Equipment
Prac	Practice
Prox	Proximity
PTT	Powder Train Time (relating to fuzes)
PWP	Plasticised White Phosphorus
RA	Rocket-Assisted
RAAM	Remote Anti-Armour Mine
RAAMS	Remote Anti-Armour Mine System
RAP	Rocket-Assisted Projectile
RCHG	Reduced CHarGe
RCL	ReCoilLess
RCV	Remotely Controlled Vehicle
RDX	Research Department eXplosive (high explosive)
RE	Radar Echo
RF	Radio Frequency
RHA	Rolled Homogeneous Armour
ROV	Remotely Operated Vehicle
RP	Red Phosphorus
RPG	Rocket-Propelled Grenade
RSP	Render-Safe Procedure
s	Second
SAA	Small Arms Ammunition
S & A	Safety and Arming
SACLOS	Semi-Automatic Command to Line Of Sight (missile guidance)
SAL	Semi-Active Laser
SAM	Surface-to-Air Missile
SAP	Semi-Armour-Piercing
SAPHEI	Semi-Armour-Piercing High-Explosive Incendiary
SAU	Safety and Arming Unit
SCBA	Self-Contained Breathing Apparatus
SD	Self-Destruct
SFF	Self-Forging Fragment
SH	Squash Head
Smk	Smoke
SQ	Super-Quick
SR	Short-Range
SSM	Surface-to-Surface Missile
SUU	Suspended Underwing Unit (USA)
T	Tracer (or TNT in explosive designations)
TMD	Tactical Munitions Dispenser
TNT	TriNitroToluene (high explosive)
TP	Target Practice or Training Practice
TSQ	Time and Super-Quick
TV	Television
UAV	Unmanned Aerial Vehicle
UDMH	Unsymmetrical DiMethylHydrazine (liquid propellant)
UN	United Nations
US	United States
UV	Ultra-Violet
UXO	UneXploded Ordnance
Vo	Muzzle velocity
VOD	Velocity Of Detonation
VT	Variable Time
WP	White Phosphorus
WWII	World War Two

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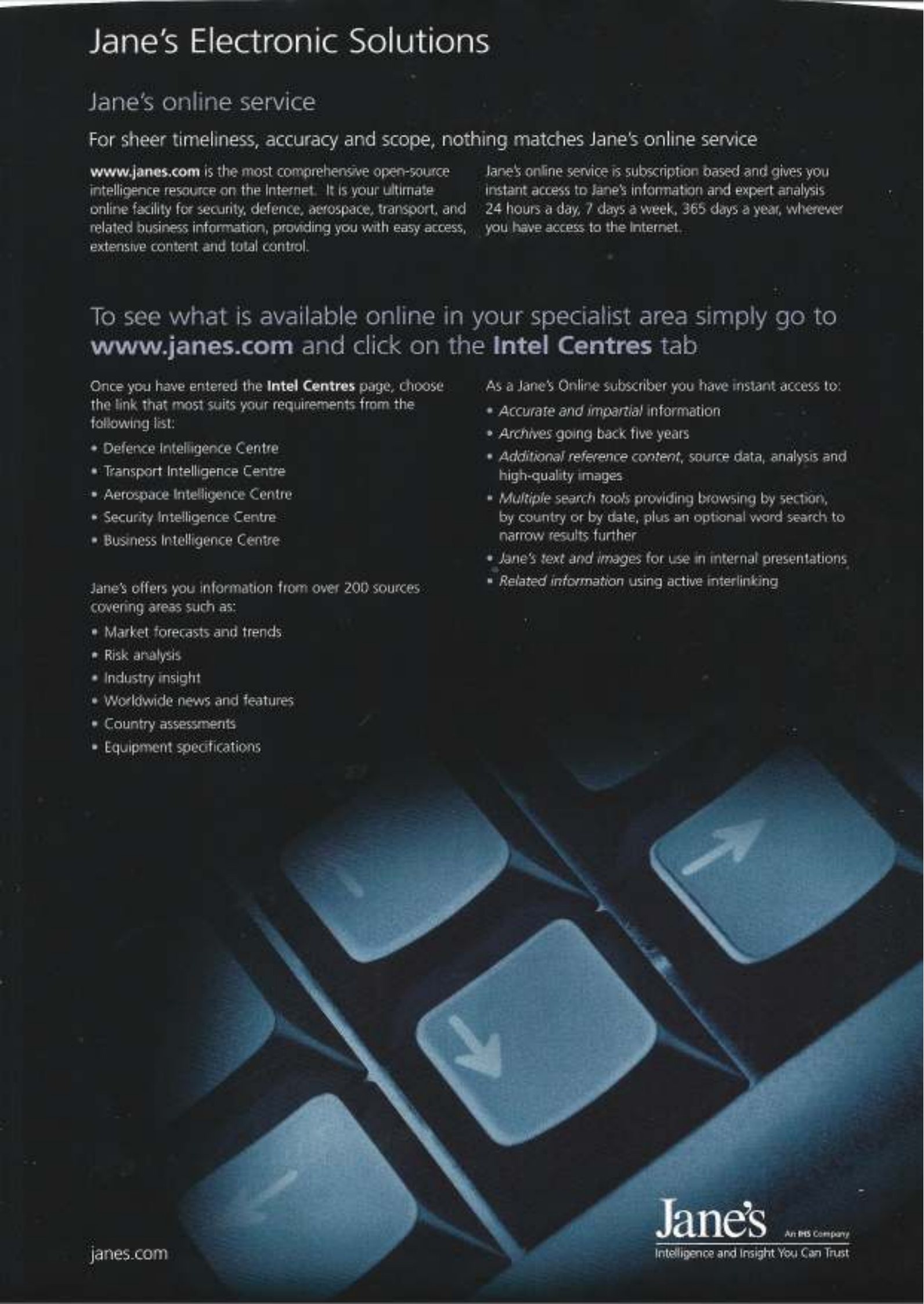

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Executive Overview

SIGNATURE RECOGNITION

Introduction

Ordnance recognition is a key component of all EOD training, although some nations focus more on individual munitions while others stress the characteristics of generic groups. Either way, technicians soon learn to identify the more common types of ammunition within their areas of operation, but it takes far longer before they can recognise internal components, or the effects that they cause. The potential value of signature recognition is enormous, ranging from the identification of hazardous areas contaminated with ordnance to establishing the cause of injury during accident investigation. The ability to identify specific weapon types is often crucial to the selection of appropriate equipment and techniques for post-conflict ordnance clearance, but may also, say, provide evidence of embargo breaking or illegal use. With intense media interest in the conduct of modern warfare - particularly the excessive use of military force - it can also help to explain events and curb misguided speculation. Signature recognition is an important skill, yet one which tends to be neglected.

Types of signature

Ordnance signatures fall into two categories; the primary indicators are components of the weapon system itself, with secondary effects being created in the target area upon initiation. Some primary indicators may be present even before the weapon functions, as in the case of a minefield; here, items such as packaging, instructions and safety devices can indicate not only that mines have been laid nearby, but also identify the types used.

Once a weapon has functioned, components generally remain in and around the point of initiation. There is a common misconception that everything close to the detonation of high explosive is 'vaporised'; there are even trained EOD operators - who should know better - that perpetuate this myth. The fact is that, other than the energetic material itself, very little is actually consumed during detonation, and what remains can provide valuable evidence to those willing and able to read the signs.

Secondary effects (those inflicted on nearby objects as the ammunition functions) include marks on the ground, damage to structures and vehicles, and wounds to people and animals. In many cases both categories of indicator are present; for example, where a fragment from a warhead strikes an object, inflicts damage, and then becomes lodged in its target.

The evidence on offer

During the Second World War, 'secondary' evidence of buried ordnance was used by EOD personnel to estimate the size, location - and sometimes even the type - of an unexploded bomb from the entry hole it left. Equally important was the ability to recognise signs of a 'camouflet', where a bomb had exploded deep underground without leaving a crater. However, while unexploded bombs continue to feature in modern conflicts, the ability to accurately interpret their signatures is increasingly rare.

Mine action is one of the few areas where the value of signature recognition *is* recognised, with many organisations teaching people how to spot signs of danger during Mine Risk Education (MRE) programs. Signatures are particularly vital to MRE since (unlike many other types of ordnance) mines are unlikely to be seen, but liable to function when encountered. While communities are taught to identify indicators such as dead animals and abandoned military positions, soldiers and deminers should be looking for less obvious features, such as discarded safety devices, which may directly identify the types of mine used. After an incident, there is almost always enough evidence remaining to identify the type of mine responsible, and even fragments recovered from the wounds of mine victims have been used for this purpose.

Similar skills have evolved for the location and identification of cluster weapons and their submunitions, which have featured so prominently in recent years. These involve recognising parts of the delivery system (bomb, cargo projectile or rocket casing), submunition and other payload components (such as ribbons and spacers) and impact marks.

Almost anyone can be shown how to differentiate between the strike marks left by a shaped charge, a fragmentation warhead and a blast weapon; from there, a broader knowledge base is built from witnessing

Entry holes from unexploded bombs were recognised as an important source of information by Second World War EOD personnel (Colin King) 0074680

Characteristic safety caps and pins indicate the nearby presence of Belgian M409 anti-personnel mines in Chad (Colin King) 1377667

the effects of different warhead sizes and configurations on a range of materials. With experience and training, the smallest ammunition components can further aid identification through their characteristic shape, markings or colour; the shade of olive green alone is often enough to indicate the country of origin. As the operator expands and combines these elements of signature recognition, they should develop the ability to 'read' a scene and understand the implications.

Recent examples

A succession of recent conflicts has illustrated the importance of correct ordnance identification and the location of contaminated areas.

After the first Gulf war, the clearance of Rockeye bomblets from soft sand became one of the more hazardous EOD tasks. Characteristic signatures on road surfaces not only revealed the presence of strikes, but the fragmentation pattern could also show the direction of the attack; this gave a good indication of which adjacent areas were likely to be contaminated.

In Lebanon, where there was extensive use of dual-purpose bomblets, there was initial confusion over the types of the submunitions and their origins. Some incorporated a self-destruct feature, which had important implications for both clearance procedures and ongoing studies into the reliability of submunitions. EOD operators and analysts soon became adept at identifying the various types from the smallest component variations; meanwhile, signatures such as internal packing, stabilising

Distinctive marks on a road in Kuwait indicate not only the presence of a submunition strike, but also reveal the type and the direction of the attack (Colin King) 0074734

Empty base-bleed units from cargo projectiles were a clear indication of submunition strikes in Lebanon (Colin King) 1375854

ribbons and projectile base-bleed units provided vital indications of cluster strikes to both local communities and survey teams.

In Georgia, during the Oslo Process to secure a ban on cluster munitions, there was intense interest in whether bomblets had been deployed and, if so, by which side. A number of components and partially functioned munitions helped to build a picture which revealed that they had indeed been used, including types about which little was known. Analysis also revealed important inconsistencies, where components from different - and sometimes unrelated - systems had been assembled for photographs as 'evidence' of misuse.

Similar images emerged during the recent Israeli invasion of Gaza, as the media documented a number of tragic incidents involving civilians. Some were determined to prove that sinister weapons, such as Dense Inert Metal Explosive (DIME) and thermobaric (enhanced blast) types, were being used. In several cases, analysis of strike signatures, wound characteristics and fragmentation allowed the munitions to be identified as anti-tank missiles with 'conventional' HEAT/fragmentation warheads. In one instance, several separate definitive indicators had to be explained to a television network before they reluctantly abandoned the sensational story they had planned.

What's missing?

The absence of an indicator can also provide important information, usually by eliminating an option. For example, a fragmentation warhead will inevitably leave marks on nearby exposed surfaces when it detonates; clearly, if there are no marks, then the weapon did not incorporate a fragmentation effect. However, such inferences require care - and sometimes a little lateral thinking - to avoid mistaken conclusions. Is it possible that the fragments were caught by something (or someone) no longer present at the scene, or were so directional that they missed some nearby surfaces? Explosive events can be complex and unpredictable, and bizarre coincidences do occur. In a school building in Kosovo, the base of a tank projectile was lodged in a hole that showed clear signs of detonation, yet the shell was live, suggesting that it had been fired into the hole left by a previous round.

The speculation in Gaza was fuelled by reports from experienced surgeons, who claimed that they had never seen wound characteristics like these before; however, despite the horrific and unusual nature of some injuries, these casualties were the victims of 'conventional' warheads, and it was the absence of signatures which most effectively countered the conjecture. In one case, the undisturbed and undamaged condition of corrugated iron roofing sheets near the point of detonation eliminated any possibility that a thermobaric weapon had been used; in another, claims that some weapons incorporated DIME warheads was quashed when forensic examination showed no indication of heavy metals, such as Tungsten.

Conclusion

All too often we hear of accidents, disasters and tragedies in everyday life where hindsight shows us that the signs were there, but nobody recognised them at the time. Police enquiries eliminate a suspect that later turns out to be the perpetrator or engineers overlook a flaw that leads to catastrophic failure. EOD operators are skilled technicians in a highly specialised and dangerous environment in which comprehensive information can be vital. Much of it is readily available, if only we can read the signs.

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On the production side, particular thanks to Melanie Rovery at Jane's, and to my assistant Jane Stevens, both of whom update substantial proportions of the content. Thanks also go to Jack Brenchley (Senior Compositor), Mike Johnson (Image Services) and Sara Morgan (Publisher) at Jane's.

The reader's contribution

I hope that this reference material will enhance the knowledge of the layman and expert alike, although it is not intended to be a substitute for specialist training. The information should be accessible and helpful to a wide range of users in and around the EOD community, so I'm particularly interested in the needs of the reader and ways in which we can better meet those needs. I am also grateful for suggestions, corrections and additional information to include in the regular online updates and new yearbook. Please direct all correspondence to the Editor of Jane's Explosive Ordnance Disposal at Jane's Information Group, Sentinel House, 163 Brighton Road, Coulsdon, Surrey, CR5 2YH, United Kingdom.

Colin King
March 2009

Colin King

Colin King graduated from Sandhurst in 1981 and served for 14 years in the British Army. Most of his career was in Explosive Ordnance Disposal (EOD), with operational service including the Falklands, the Persian Gulf and Bosnia. He also led the first British Army team to train Afghan deminers during the UN Operation Salam. In addition to field work, he was an instructor at the British EOD school and spent six years working as the sole EOD analyst on foreign munitions for the Ministry of Defence.

He left the army after serving as a Squadron Commander with the Gurkhas in Hong Kong, and founded an EOD consultancy company together with his wife, Jo. He now edits the Jane's reference yearbooks *Mines and Mine Clearance* and *Explosive Ordnance Disposal*. Operational work, training and national programme assessments have led to experience in a wide range of countries, including Azerbaijan, Bosnia, Cambodia, Chad, Chile, Ecuador, Egypt, Iraq, Jordan, Kosovo, Kuwait, Lebanon, Oman, Rwanda and Yemen. He was a technical advisor to the recent Oslo Process which led to the Convention on Cluster munitions, and is currently engaged on a number of programs related to the disposal of landmines and cluster munitions.

Melanie Rovery

Melanie Rovery joined Jane's Information Group in 1997, working within the land/sea/air portfolio of reference titles. During this time she has gained valuable knowledge within the defence equipment industry. She has spent the past two years solely involved in the land area of the company at a managerial level for a number of land publications. Melanie took over the the Equipment and Services sections of *Jane's Mines and Mine Clearance* and *Jane's Explosive Ordnance Disposal* at the beginning of 2007. Melanie previously edited *Jane's Simulation and Training Systems* for just over two years and has contributed to *Jane's International Defence Review*.

BACKGROUND INFORMATION

Explosives and propellants

Introduction
Detonators
Primary high explosives
Secondary high explosives
Liquid propellants
Solid propellants

EOD equipment

Abrasive cutting equipment
De-armers
Disruptors
Explosives for EOD
Hook and line
Incendiaries for EOD
Low-order techniques
Mechanical fuze wrenches
Rocket wrench
Stethoscopes, electronic
X-Ray inspection

High explosives. From the top left clockwise: Bosnian detonating cord, a US 1 lb TNT demolition block, US C-4 plastic explosive and a 200 g block of TNT (Colin King) 1042368

Demolition of landmines in the Falkland Islands; the black smoke is characteristic of TNT (Colin King) 0018963

1 oz primers scattered on the ground in Iraq (Colin King) 1342177

EXPLOSIVES AND PROPELLANTS

INTRODUCTION

The purpose of the following entries is to give a brief introduction to explosives and propellants, since these are fundamental to the characteristics of munitions. Most modern munitions rely on the use of energetic materials to release their energy on demand, and all of these materials can be loosely classified as 'explosives'. In general, the term 'explosive' is used for materials that release their energy very rapidly, and are normally employed for their destructive effects. Those with a slower release of energy are generally used to accelerate objects in a controlled manner, and are classed as 'propellants'.

There are hundreds of different explosives, and confusion is often caused by the use of different national terms or designations for similar types. For reference, the more common military, commercial and home-made explosives are listed and cross-referenced in the *Identification* section. Explosives markings and fill designators can also be found in this section.

Categories of high explosive

High explosives are subdivided into two categories; primary and secondary. Primary high explosives are sensitive to heat and shock; they are therefore used in detonators to initiate the less sensitive, but more powerful, secondary explosives. A third category of 'boosters' (sometimes known as 'primers') was commonly used to refer to the more sensitive secondary explosives that were employed as intermediate charges to ensure the successful initiation of larger charges. Strictly speaking, the explosives routinely used in boosters, such as Tetryl, PETN and RDX, fall into the category of secondary high explosives. However, the term is still used to refer to a warhead component whose function is to propagate the shock wave from a detonator to the main HE charge.

Characteristics of high explosives

High explosives are defined by their ability to 'detonate'. Detonation is the sustained propagation of a supersonic shockwave through an energetic material, and is quite different from the explosion caused by rapid burning of early 'low' explosives, such as gunpowder. The rate at which this shockwave progresses is known as the velocity of detonation, and will be between 1,800 and 9,000 m/s in solid and liquid explosives.

Detonation pressure is also an important explosive characteristic, particularly in the performance of shaped charges. Detonation pressure is the peak dynamic pressure in the shock front, usually quoted in thousands of bar (kbar), but more properly stated in Gigapascals (GPa). It is a function of both explosive density and velocity of detonation but, being proportional to the square of the velocity, a modest increase produces a substantial gain in detonation pressure. This is why explosives with high detonation velocities, such as RDX and HMX, are commonly used in shaped charges, where pressure is key to performance.

There are two tests commonly used to indicate the performance of explosives. The 'Trauzl test', sometimes known as the 'Lead block test' is a method used to compare the 'strength' of different explosives. A 10 g sample of the test explosive is detonated in a cavity within a lead block; the resultant increase in the cavity's volume is then measured to indicate performance.

The 'Sand test' is used to determine the 'brissance', or shattering effect, of an explosive by detonating a small sample in sand of a known grain size. The amount of sand crushed into finer grains indicates the brissance of the explosive.

More detailed characteristics of high explosives are given in separate entries in this section; see *Detonators, Primary high explosives* and *Secondary high explosives*.

Propellants

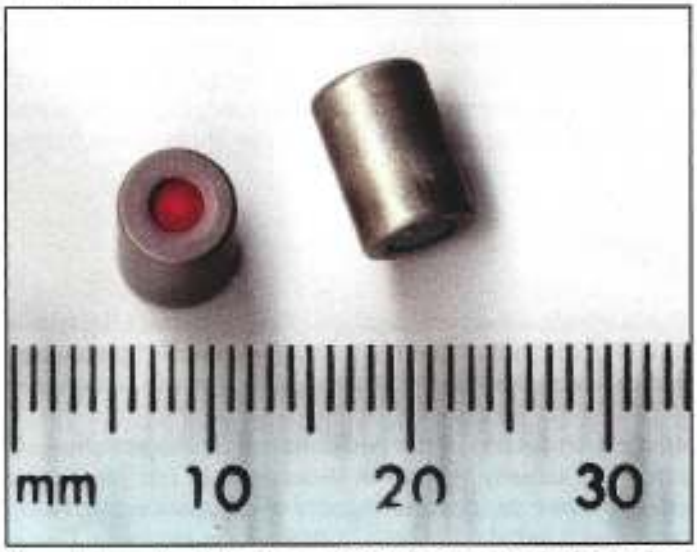
Propellants may be found in almost any type of munition. In addition to their better-known roles in cartridge cases and rocket motors, propellants are also used for ejection charges in mines, bombs and projectiles, and as gas generators within munitions and fuzes. Propellants can be either liquid or solid, though solid types are far more common in military applications. Although propellants release their energy more slowly than high explosives, the reaction can still be extremely fast, and may occur within a fraction of a second; the effect is violent and often 'explosive', even with rocket motors. The surface area of a propellant is critical to controlling the burn rate and thereby generating the correct pressure. Solid propellant is generally extruded into 'grains' of different shapes to regulate the surface area, although the size of these grains can vary tremendously. Propellant grains in a small arms cartridge may be around 1 mm in diameter, while a large rocket motor may contain a single grain several metres long. If a rocket motor is damaged, the large propellant grains may become cracked or detached from the side wall of their containment vessel, increasing the surface area; on initiation, the accelerated burn rate can cause the motor to explode.

It is also important to remember that propellants can be initiated far more easily than secondary high explosives; virtually any source of ignition can light propellant whereas the initiation of secondary high explosive generally requires the substantial shock produced by a detonator. The widespread misconception that propellants are somehow 'safer' than high explosives – and therefore demand less respect – has led to many fatal accidents.

The *Solid Propellants* and *Liquid Propellants* entries in this section give a brief introduction to this complex category of explosives.

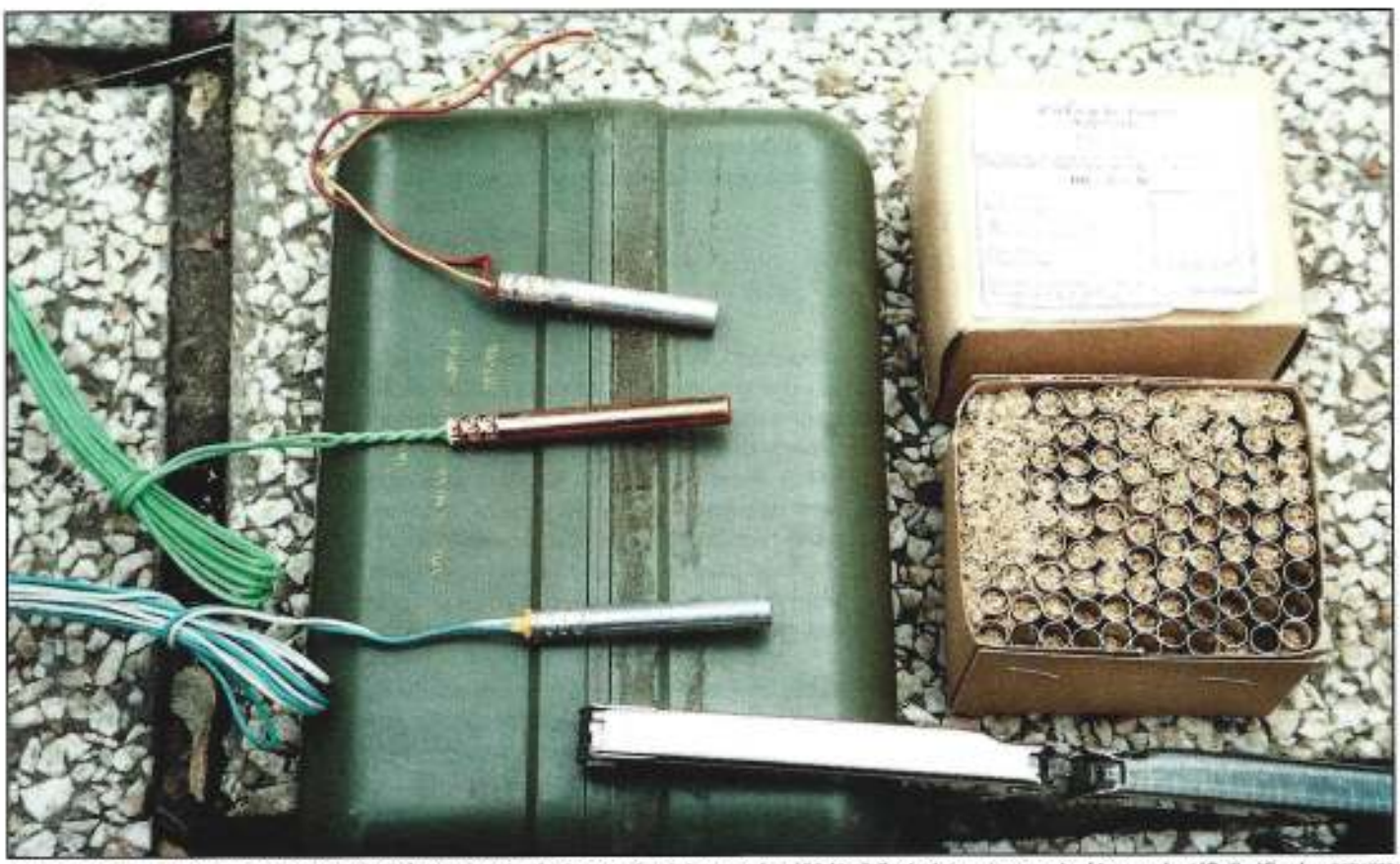
Electric detonators. Note the different types of tube, crimp, sealing plug and leads, all of which are important identification features (Colin King) 1198960

Non-electric or 'flash' detonators (Colin King) 1198961



These stab-sensitive detonators, used in landmines, are only nine mm long. Despite their size, detonators can do a great deal of damage to the body (Colin King) 0572359

The Yugoslav M67 percussion detonator (Colin King) 1342178



Detonators found in Bosnia. Those on the left are electric; the box to the right contains 100 No 8 flash detonators packed in sawdust (Colin King) 0074673

DETONATORS

Conventional detonators

Detonators, often known as 'blasting caps' in the US, are the devices normally used to initiate HE charges. Conventional detonators normally consist of a tube containing a small charge of primary high explosive above a pellet of more powerful secondary explosive: an additional flash-receptive layer may also be incorporated. During manufacture of the detonator, the primary explosive is pressed; the density of the pressed compound affects the characteristics, increasing power and detonation velocity, but reducing sensitivity. The tube (normally aluminium or copper) may also incorporate compounds or components to aid the initiation process. Detonators are normally initiated by one of four means; directly from a source of heat (such as burning safety fuse), electrically (normally via an internal 'bridge wire' element), by the action of a striker on a percussion cap, or using friction. Friction is used in 'stab-sensitive' detonators, where the friction-sensitive composition is initiated by the penetration of a sharp pointed striker or needle. Percussion and stab-sensitive detonators normally function immediately when initiated, but electric and flash detonators may incorporate short delays.

Detonators are rated for power, the most common being 'No 8 strength', which is capable of detonating TNT without the need for an additional booster. Detonators typically contain little more than 1 g of high explosive, of which only a fraction need be primary explosive. For example, in a Russian TAT-8A detonator, the primary explosives lead styphnate and lead azide are combined with a Tetryl booster in an aluminium tube. The combined weight of the two primary explosives is only 0.3 g, while the Tetryl pellet is 1.02 g. In the TAG-8A, Tetryl is replaced by an RDX pellet of the same weight. The number 8 in the designation denotes that these are No 8 strength detonators. No 6 detonators, which generally require the use of a booster to initiate TNT, are rarely used now, but may still be encountered in some regions.

Since they are protected by the structure of the munition and are in intimate contact with a booster or main charge, the detonators used in ordnance can be far smaller than those used in demolition work. Many are 'stab sensitive' and are therefore highly vulnerable to initiation once exposed; despite their size they can cause serious injury and their power should never be underestimated. See also the introduction to *Explosives and propellants* in this section.

Identification

The characteristics of electric and non-electric detonators normally allow them to be traced to their manufacturer. The main identification features for detonators are:

- Type of initiation (electric or non-electric)
- Tube material
- Head stamp (on end of tube)
- Markings on tube
- Colour of lead wires
- Colour of sealing plug
- Type of crimp
- Length and diameter of tube

Special detonators

Recently, electronic detonators have been produced to incorporate an onboard microprocessor. These have the benefits of very accurate delays and being fully testable from the firing point. Currently, their main application is in specialist commercial demolition.

For particularly demanding applications, such as high-velocity missiles and nuclear weapons, special detonators (sometimes known as 'slappers') are required; these have to be extremely safe, reliable and fast-acting. Two types of special detonator have emerged; the Exploding Bridge Wire (EBW) and its successor, the Exploding Foil Initiator (EFI).

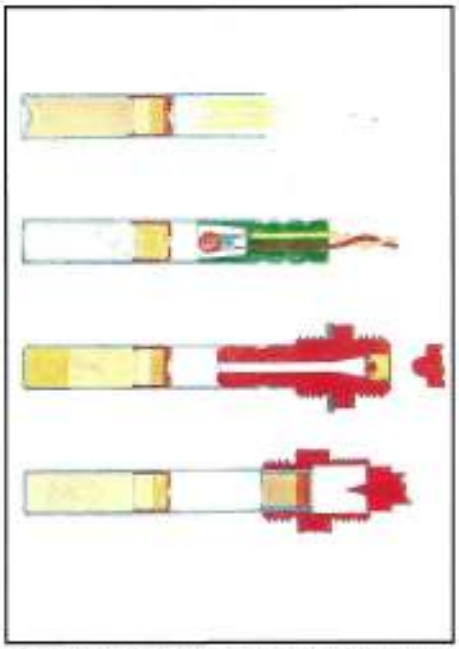
While a conventional electric detonator requires around 1 W of electrical power for initiation, the EBW uses around 100,000 W to vaporise a bridge wire. This creates sufficient heat and shock to initiate a small charge of secondary high explosive, eliminating the need for sensitive primary explosive. Using an EBW, detonation occurs within a few microseconds.

The EFI uses an even greater charge (typically around 3,000,000 W) to vaporise a bridge foil, driving the adjacent surface onto a pellet of secondary high explosive. The EFI is even less vulnerable to accidental initiation than the EBW and functions in around one microsecond. The extremely rapid initiation of these detonators allows the very precise timing needed for special applications.

EBW and EFI detonators require special dedicated firing systems and are completely unsuitable for use in most conventional applications.

Primary high explosives are normally incorporated into detonators, also known as blasting caps (Colin King) 1042368

Flasks of mercury, ready for the production of the primary explosive mercury fulminate (Colin King) 1342179



Common ways to initiate primary explosive in detonators. From the top: flash, electric squib, percussion and stab (Lyn Haywood) 0056034

PRIMARY HIGH EXPLOSIVES

Introduction

Primary explosives are sensitive compounds that are used, in detonators, to initiate larger charges. Their sensitivity makes them unsuitable for use as a bulk munition filling, and most are substantially less powerful than secondary explosives anyway. Primary explosives are basically initiated either by heat or shock, but their properties can be modified by the addition of other compounds (such as tetrazene, potassium chlorate, barium nitrate, antimony sulphide and ground glass) to make them more sensitive to friction or impact.

Although there are many primary explosives, very few have the right characteristics for commercial or military use. Some are chemically unstable and prone to deterioration while others are simply too sensitive to use. Some compounds are relatively simple to make from commonly-available substances, which has led to their use by terrorist organisations. One example that has risen to prominence recently is Triacetone Triperoxide (TATP). From the terrorist viewpoint, its high sensitivity has the advantage that it requires no detonator and can be initiated by heat or impact. Compared to other primary explosives, it is also extremely powerful – around 80 per cent of the power of TNT. However, TATP's sensitivity also makes it extremely dangerous to make and use, while its poor stability limits its usability to a matter of days.

For military and commercial applications, earlier primary explosives, such as mercury fulminate, have largely been replaced by compounds with greater stability, such as lead azide and lead styphnate. In practical applications, primary explosives are almost always mixed with other substances and combined with more powerful explosives in a small tube (normally aluminium or copper) to form a detonator assembly or blasting cap. The process of pressing the primary explosive into the tube reduces its sensitivity, while also offering a degree of mechanical protection. However, detonators should always be handled with the greatest of care; they should always be protected from impact, heat and sources of electrostatic energy. Purpose-built facilities for handling munitions and explosives incorporate lightning conductors and anti-static precautions such as earthing points and conductive flooring. In the field, EOD technicians must always take care to minimise the possibility of static build-up or discharge. For more information about primary explosives, see the introduction to *Explosives and propellants*, and the entry on *Detonators* in this section.

The following table gives the properties of some common primary explosives.

Primary explosive	Velocity of detonation (m/s)	Detonation pressure (approx) (kbar)	Approximate power (as percentage of TNT)	Temperature at which detonation occurs within 5 s (°C)	Electrostatic sensitivity (Joules)
Remarks	Dependent on density		Using the Trauzl Test	Sample unconfined, sustained for 5 s	
lead azide	4,500–5,400	192	40	315–345	0.01
lead styphnate	4,900–5,200	157	42	282	0.0009
mercury fulminate	4,000–5,400	167	37–50	210	0.025
Triacetone Triperoxide (TATP)	5,300	n/k	80	n/k	n/k

A small selection from the hundreds of commercial explosives in use. These may end up in IEDs or locally manufactured munitions (Colin King) 0074334

A cast TNT block. Note the characteristic grainy pattern on the surface, and that the explosive darkens on exposure to light (Colin King) 0534034

A 1 kg block of Semtex-H. Despite its reputation, Semtex-H is just a plasticised RDX/PETN mixture with orange dye, no more powerful than US C4 (Colin King) 0074335

Detonating cord is available in many colours and is normally supplied on reels (Colin King) 1198862

This red detonating cord is common in Iraq, where it has been used in many IEDs (Colin King) 1198863

Slabs of US C4 plastic explosive (Colin King) 1041000

SECONDARY HIGH EXPLOSIVES

Military Explosives

Secondary explosives are the more powerful and stable substances used for the bursting fillings in munitions and for demolition. Picric acid (also known as 'trinitrophenol' or 'lyddite') was used extensively for filling shells before the First World War; this was largely replaced by TNT and Amatol (TNT/ammonium nitrate mixture) during both World Wars, with tetryl used for boosters. During the Second World War, PETN, RDX and HMX (a higher-density analogue of RDX) gained recognition and were incorporated into some munitions.

These explosives are still used in the majority of military applications, although they are often found in combination (such as RDX/TNT), or in mixtures with other substances. Explosives and mixtures are often known by different names in other countries, which can lead to confusion. Tables listing the various names and terms for explosives and propellants are available in the *Identification* section. Additives are used to alter the properties or characteristics of an explosive for a specific application. For example, aluminium enhances the blast effect while plasticisers allow manual shaping and decrease sensitivity. The relatively high sensitivity of explosives such as Tetryl, PETN and RDX makes them useful as boosters in an explosive train. However, they are too shock sensitive for most military applications and are normally mixed with less sensitive explosive (such as TNT) or inert lubricating compounds, such as mineral oil or wax.

Most modern 'plastic explosives' are based on RDX and PETN mixed with 5 to 15 per cent plasticiser, including compounds such as lithium stearate, polyisobutylene and vaseline. The increasing demand for 'insensitive' explosives for use in munitions has led to a wide range of Polymer Bonded Explosives (PBX), in which explosives such as RDX and HMX are bound into a matrix of synthetic polymer (typically 5–10% by weight). The resulting mixtures can be cast, pressed and even machined in to precise shapes, which retain their integrity under extreme conditions.

Most modern military explosives have good long-term stability, meaning that their sensitivity is unlikely to change significantly, although associated fuzing mechanisms and primary explosives may be less predictable. One notable exception is Picric acid, which is known to form sensitive compounds with metals such as copper.

The following table shows the characteristics of some common military explosives.

Secondary explosive	Velocity of detonation (m/s)	Detonation pressure (kbar)	Approximate power (as percentage of TNT)	Relative brissance (as percentage of TNT)	Temperature at which detonation occurs (°C)
Remarks	Dependent on density	Typical	Using the Trauzl Test	Using the Sand Test	Sample unconfined, sustained for 5 s
HMX	9,110	392	159 – 165	125	327
PETN	7,500 – 8,300	300	161 – 189	129 – 141	215
RDX	8,440 – 8,700	300	151 – 170	125 – 145	316
Tetryl	7,160 – 7,850	192	125 – 145	113 – 123	257
TNT	6,800 – 7,000	190	100	100	475

Commercial explosives

There is also a huge selection of commercial explosives, used in applications ranging from quarrying to meat tenderisation. Few of these commercial explosives are suitable for military use; most cannot easily be melted, poured or pressed into a munition filling, and many do not have the long-term stability demanded for the storage of ordnance. Some commercial quarrying and mining explosives are designed with a low detonation velocity (for example, ANFO: 2,000–3,000 m/s) to 'push' rather than shatter; this too conflicts with the military requirement, where a powerful shattering effect ('brissance') and high detonation pressure are normally desirable. Because of their availability, commercial explosives are often used in Improvised Explosive Devices (IEDs).

Detonating cord

Detonating cord (sometimes known as 'det cord' or 'Cordtex') is basically a thin, high-explosive cord, similar in appearance to washing line. It has a core of white powdered PETN wrapped in hemp or jute twine and coated with plastic, which may be any colour. It is mainly used to connect detonators to remotely placed charges, or to form a connection between adjacent charges; since the velocity of detonation is in the region of 7,000 m/s, this results in virtually simultaneous detonation. However, the very slight delay can also be utilised to initiate a rapid sequence, or ripple, of explosions for some demolition purposes. Detonating cord is available in various grades, containing different amounts of explosive for a given length. The grades are normally quoted in grams per metre, with the most common types containing around 12 g of PETN per metre. Detonating cord is a powerful explosive expedient in its own right and multiple strands can, for example, cut down a small tree or breach a brick wall.

An SA-2 missile in Iraq; leaking hypergolic fuel is likely to cause initiation (Colin King) 1041001

Drums of fuel for SA-2 missiles in Iraq (Colin King) 1198907

Leaking IRFNA tanks at an SA-2 missile fuelling site in Iraq (Colin King) 0572357

An SA-2 missile during the first Gulf War. Damage to the missile and storage tank mean that there is a high risk from leaking liquid propellant
(Colin King)
0074297

LIQUID PROPELLANTS

Liquid propellants

Although the use of liquid propellants was proposed in the late 19th century, most development occurred in Germany during the Second World War. The engine for the V-2 rocket, which used an alcohol/water mixture and liquid oxygen, was many times more powerful than any rocket motor previously developed and formed the basis for the first generation of American and Russian ballistic missiles. The need to store and transport oxidant more easily led to the adoption of compositions based on nitric acid, while more energetic fuels based on liquid hydrocarbons were also developed.

Applications. Although liquid propellants have largely been replaced by solid motors in most applications, they are still used in some older weapon systems; mostly in the sustainer motors of large missiles. The most commonly encountered examples are the Russian SA-2 'Guideline' high-altitude surface-to-air missile, the Russian SS-N-2 'Styx' anti-ship missile and Chinese copies, such as the HY-1 'Silkworm' and HY-2 'Seersucker'. Russian rocket motors have also been used, or copied, in several indigenous ballistic missile programs. The Indian 'Prithvi' and Iraqi 'Al Samoud' missiles were based on the SA-2 motor, while the North Korean 'Hwasong' missile series were based on Scud. Other liquid-fuelled missiles include the North Korean Nodong and Taepo'dong, the Iranian Shahab 3 and the Pakistan Hatf 5.

Liquid propellants are divided into two categories; monopropellants and bipropellants.

Monopropellants. Monopropellants which decompose on ignition, such as IsoPropyl Nitrate (IPN) and nitromethane, are known as 'monergols'.

Monopropellants which are decomposed in the presence of a catalyst are known as 'catergols', and include hydrazine and hydrogen peroxide. Although rarely used as a propellant in modern munitions, monopropellants may be encountered in gas generators, which are used to drive turbines or move control surfaces in some missiles. A newer monopropellant has emerged from recent missile research; hydroxylammonium nitrate (HAN) is less toxic than hydrazine and has a higher 'specific impulse' (a power rating, abbreviated to 'Isp')

Bipropellants. Bipropellants use a combination of a fuel and an oxidant. Most military bipropellants ignite spontaneously when mixed; these are known as 'hypergolic'. The most common examples are the fuels kerosene and Unsymmetrical DiMethyl Hydrazine (UDMH), and the oxidant Red Fuming nitric acid (RFNA). Although RFNA is composed mainly of nitric acid, this only comprises about 70 per cent; the remainder may include sulphuric acid, phosphoric acid, and dinitrogen tetroxide (which is largely responsible for the colour and red/brown fumes). Hydrofluoric acid is generally added to inhibit corrosion, the resultant composition being known as Inhibited Red Fuming Nitric Acid, or IRFNA. The proportions are varied to alter the characteristics of the oxidant, with compositions containing less than 0.5% nitrogen dioxide known as White Fuming Nitric Acid (WFNA). IRFNA has a maximum storage life of 5 years and should be stored below 20°C to avoid rapid deterioration. These compositions are used in missiles such as the Chinese HY-2 'Silkworm', the Russian SA-2, Styx and Scud-B, and the US 'Lance'.

Those bipropellants that require a source of ignition after mixing are known as 'non-hypergolic'. These include liquified hydrogen and oxygen but, since these are cryogenic materials, they are not suited to battlefield use.

Liquid propellants must always be handled with care, but they are particularly dangerous in unexploded ordnance, where damage or poor maintenance may lead to leakage. In addition to the significant risk from spontaneous combustion or explosion, many liquid propellants are highly toxic or corrosive. Protective clothing and breathing apparatus are required when working near hydrazine, UDMH, IRFNA or hydrogen peroxide, in concentrations as low as 5 parts per million.

For more information, see also the separate entry on *Liquid propellants* in the *Identification* section, and *Liquid fuelled missiles* under *Types of unexploded ordnance*.

A large composite propellant grain from a surface-to-air missile. In addition to venting the gaseous combustion products, the shape of the central void is designed to increase surface area, creating a faster burn and greater thrust (Colin King) 0074674

Stick and grain propellant emptied out of artillery rounds by looters in Iraq creates a major fire hazard (Colin King) 0572356

SOLID PROPELLANTS

Solid propellants

Solid propellants are normally divided into four categories: single-based, double-based, triple-based and composite. Additionally, gunpowder (or 'black powder') is still used as a propellant in applications such as ejection charges, although it is sometimes classified as an explosive. Propellants based on nitrocellulose and nitroglycerine contain a number of additives, including stabilisers, plasticisers, burning rate modifiers, flash inhibitors and anti-wear agents.

Single-based. Nitrocellulose is the only explosive component in single-based propellants, which typically have energy values between 3,100 and 3,700 J/g. For use as a propellant, the energy level of nitrocellulose can be controlled by varying the degree of nitration during the manufacturing process. Highly nitrated nitrocellulose (known as Guncotton) is a secondary high explosive with a typical density of 1.3 and a detonation velocity around 7,300 m/s. For use as a propellant, nitrocellulose is normally mixed with organic solvents and additives before being extruded into the desired shape.

Double-based. Nitroglycerine and nitrocellulose are mixed in double-based propellants, such as ballistite and cordite; the addition of nitroglycerine typically increases the energetic value of the propellant to between 3,300 and 5,200 J/g. In isolation, nitroglycerine has a typical density of 1.6 and a detonation velocity around 7,700 m/s. Double-based propellants are used extensively in rockets, but their artillery and small-arms applications are limited by their heat of combustion and consequent erosive effects.

Triple-based. Triple-based propellants contain a large proportion of nitroguanidine (up to 55 per cent by weight). They produce less flash and are less erosive than single and double-based types, but are more difficult to ignite. They have intermediate energy levels, normally between 3,200 and 3,700 J/g. Nitroguanidine, also known as 'Picrite,' is a secondary high explosive with a typical density of 1.7 and a detonation velocity around 8,100 m/s.

Composites. Composite propellants are made by binding an oxidising agent into a polymer matrix, and are now used in a wide range of rocket and missile motors. Early versions used ammonium nitrate as the oxidiser, but more modern types are based on ammonium perchlorate.

First-generation composites used thermoplastic binders such as Polystyrene, PolyVinyl Chloride (PVC) and PolyIsoButylene (PIB). These were followed by 'rubbery' composites based on PolyUrethane (PU) which, in turn, have been replaced by compositions based on Polybutadiene: Hydroxyl Terminated PolyButadiene (HTPB) and Carboxyl Terminated PolyButadiene (CTPB).

In addition to their power, composite propellants have similar advantages to Polymer Bonded Explosives (PBX). These include their ability to be cast, pressed and machined to precise shapes, their integrity under extreme conditions and a substantial decrease in sensitivity.

Typical composite propellants are approximately 60 to 70 per cent ammonium perchlorate and only 10 to 12 per cent CTPB or HTPB binder. The remaining ingredients may include aluminium and High Melting Explosive (HMX) high explosive. The fumes from burning composite propellants are particularly unpleasant due to the presence of polymer binders.

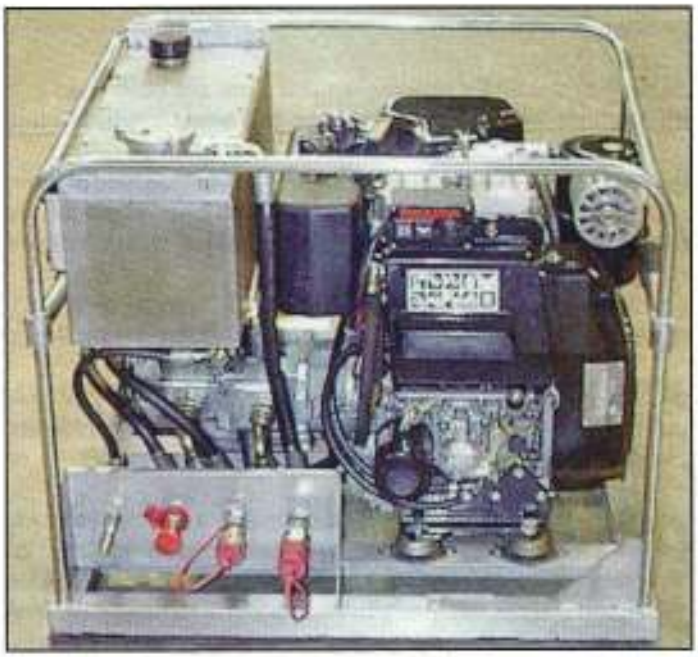
Shapes. Solid propellants are normally extruded into shaped 'grains', which may vary in size between a few millimetres and several metres. Small grains, such as those used in small-arms ammunition, are generally extruded in the form of cords, ribbons or tubes, and may be cut into short lengths to further increase surface area. Larger cylindrical grains may be tubular, contain multiple tubes, or have star-shaped central voids. These shapes are used to regulate the exposed surface area and thereby control the rate of burn and resultant pressure. For any given propellant, the larger the exposed surface, the faster the rate of burn and the resultant evolution of gaseous products.

Stability. Although they are not designed to detonate, damaged propellants can explode under some circumstances. This is often because their surface area has been increased by crackling, or (in the case of large rocket motors) by separation from the casing. Some propellants are also prone to increased sensitivity through decomposition, which can lead to the separation of explosive mixtures and the deterioration of additives. Most propellants are also more easily ignited than explosives, with accidental fires spreading rapidly and uncontrollably.

A typical ACE set up against a Russian bomb in Afghanistan (Cliff Wright) 0529561

Close-up of the cutting head and hole made by ACE (Cliff Wright) 0529562

Mobile Abrasive Cutting Equipment (MACE) set up against a bomb (ANT AG) 0074824



The power pack and mixing units from the 'Swordfish' (Remotec De-Mil Systems) 0074345

The power pack and mixing units from the 'Swordfish' (Remotec De-Mil Systems) 0074346

The trailer-mounted power pack of a Marlin ACE. Note the two pressure vessels on the right of the unit (Colin King) 0529563

EOD EQUIPMENT

ABRASIVE CUTTING EQUIPMENT (ACE)

Primary uses

Hydro-abrasive cutting equipment, more commonly known as 'ACE', is a versatile means of case entry that has been proven in a wide variety of demilitarisation applications. The size and complexity of the equipment has recently been reduced to allow operational use in the field where, for example, it can replace mechanical trepanning sets.

Description

ACE is a remotely controlled, spark-free, cold cutting system designed primarily to gain access through ordnance casings. The equipment consists of three main sub-assemblies:

- Power unit
- Mixing unit
- Cutting head/manipulator.

Water is fed into the system, normally from an external supply; cutting is achieved using a slurry mix of water and abrasive (usually garnet) pumped through a cutting nozzle to create a high-pressure jet. The nozzle is mounted on a frame which is placed next to, or over, the target munition and can be manipulated in any axis to execute a wide variety of cuts. The system is operated from a control point up to 500 metres away from the target munition.

Operational details

Typical Operation

Current ACE requires a minimum of two people to set the equipment up for operation. The mixing unit is connected to the power unit; this assembly is then connected to the cutting head/manipulator via a hose. The manipulator is then connected to the control unit. The operator will normally site the nozzle between 15 and 30 mm from the surface to be cut, ensuring that the nozzle cannot make contact with the munition during manipulation.

The abrasive medium is loaded into pressure vessels on the mixer unit; on average, one loaded pressure vessel will provide 8 minutes of cutting time. ACE generally requires an external water source, although some models do have a small water tank fitted on the mixing unit; average consumption of water is approximately 8 litres per minute. Once set up and primed, the system is ready for operation. The operator controls the cutting process from the power unit, or from a stand-alone control pack. When the power unit is started, water and abrasive is mixed at the mixer unit and the slurry is pumped through the nozzle at the cutting head. The pressure of the slurry as it exits the nozzle is approximately 4,000 psi (275 bar). The cut results purely from the abrasive effect of the slurry eroding the surface of the target, the cutting head remaining stationary until the casing has been penetrated, after which it is manipulated from the control unit to achieve the desired cut. Given sufficient time, almost any thickness of casing can be penetrated, resulting in a remarkably smooth cut line just a few millimetres wide. With two pressure vessels, one can be refilled while the other is in use, thereby permitting uninterrupted operation during a cut.

Disadvantages of ACE include the requirement for relatively large amounts of water and cutting medium, and the processing or disposal of the used fluid once it has been contaminated with explosive.

EOD considerations

- There is always a possibility that a munition will detonate during the use of ACE
- All appropriate safety distances and other precautions should be observed throughout the cutting process
- The cut should be located well away from fuzes, circuitry and primary explosive
- Sensitive fuzes (either mechanical or electronic) may be initiated
- Electrical circuits may be cut or short-circuited during operation
- Provision must be made for collection/processing of contaminated fluid.

Variations

Several versions of ACE are available, in various configurations. Man-portable units are most commonly used for EOD operations in the field, while trailer-mounted and fixed installations are better suited to demilitarisation work. The larger variants produce a greater output and typically work at higher operating pressures. Smaller mobile units can now be mounted on Remotely Operated Vehicles (ROVs), giving them a wide range of additional capabilities. In addition to utilising the mobility of the vehicle, the ROV's control arm can be used to manipulate the cutting head; most vehicles are also fitted with TV cameras for remote observation. The mobile ACE permits a variety of applications for the disposal of improvised explosive devices, such as gaining access to suitcases or vehicle body panels.

Notes

Results with hydro-abrasive cutting have been consistently good, however, the possibility of accidental initiation must always be considered. For fixed installations, remotely controlled bandsaws offer a cheap alternative to ACE. Used with cutting fluid, these have proven effective in cutting through a variety of munitions, including fuzes and primary explosive, without causing initiation.

The ABL 900 'Dragon' de-armer uses an electrically initiated .50 in cartridge and is shown here fitted with a recoil-reducing barrel (ABP) 0074306

The results of a chisel slug used against a 'pipe bomb' IED
(ABP)
0074304

ABL 1000 is a combined recoilless disruptor and de-armer, shown here with a selection of steel slugs
(Colin King)
0572358

DE-ARMERS

Primary uses

The de-armer is a remotely fired EOD weapon used to disable certain types of munition fuze. The equipment works by inflicting damage in such a way that the mechanism cannot function as designed; it is particularly suited to fuzes that incorporate 'cocked strikers'. De-armers are sometimes used to gain access to munitions or Improvised Explosive Devices (IEDs), such as 'pipe bombs' (see photographs). Many of the newer de-armers can also be used as 'disruptors' (see separate entry on *Disruptors*).

Description

Most de-armers consist of a short, heavy-duty barrel with a parallel bore, chambered to accept a propellant cartridge and threaded for a screw-in breach block. De-armers are normally designed to use electrically initiated cartridges, the most common being based on the .50 inch calibre blank. The weapon normally fires steel slugs of various shapes, but some can be filled with water, sand or other materials for use as a disruptor.

Operational details

Typical operation

The de-armer is normally prepared at the Incident Control Point (ICP). A propellant cartridge is inserted into the breach and the breach block screwed into the barrel. Electrically initiated cartridges have short leads attached, which emerge through a hole in the breach block and are connected to a firing cable. For conventional munitions, the EOD technician normally refers to EOD Render Safe Procedures (RSPs) to select the appropriate shape of slug for a particular fuze, and approaches the target, manually or with the weapon mounted on a Remotely Operated Vehicle (ROV), while the firing cable is paid out from a reel at the ICP. Manual approaches are more likely to be used for conventional weapons, and ROVs for IED tasks. For a manual approach, once at the target the operator inserts the slug into the muzzle of the barrel and places the weapon in accordance with exact instructions in the RSP. If a mounting stand is not available and the weapon is not recoilless, sandbags may be needed to secure the de-armer into place and restrict the movement of the barrel during firing. The operator then withdraws to the ICP, connects an electrical firing device and (having issued a suitable warning) fires the weapon.

Against a cocked striker fuze, the slug is generally used to shear off, separate or bend part of the fuze mechanism so that the spring-loaded striker is jammed away from the initiator. A chisel-shaped slug can normally cut through a tubular steel 'pipe bomb' up to approximately 50 mm diameter.

Against IEDs, the objective may be to displace, disrupt or destroy the item, or as a means of case entry, to gain access to internal charges and components.

EOD considerations

- De-armers should be afforded the same safety procedures used with firearms
- The de-armer should be placed with consideration to the downrange hazard from the slug
- When using electrical initiation, radio frequency precautions should be observed to avoid premature initiation
- A de-armer may initiate a munition, particularly if the fuze has already been damaged
- A de-armer may initiate sensitive explosive, including some home-made explosives
- The point of aim should avoid detonators and boosters
- Standard de-armers can recoil with considerable force and may be thrown a substantial distance (unless firmly anchored).

Variations

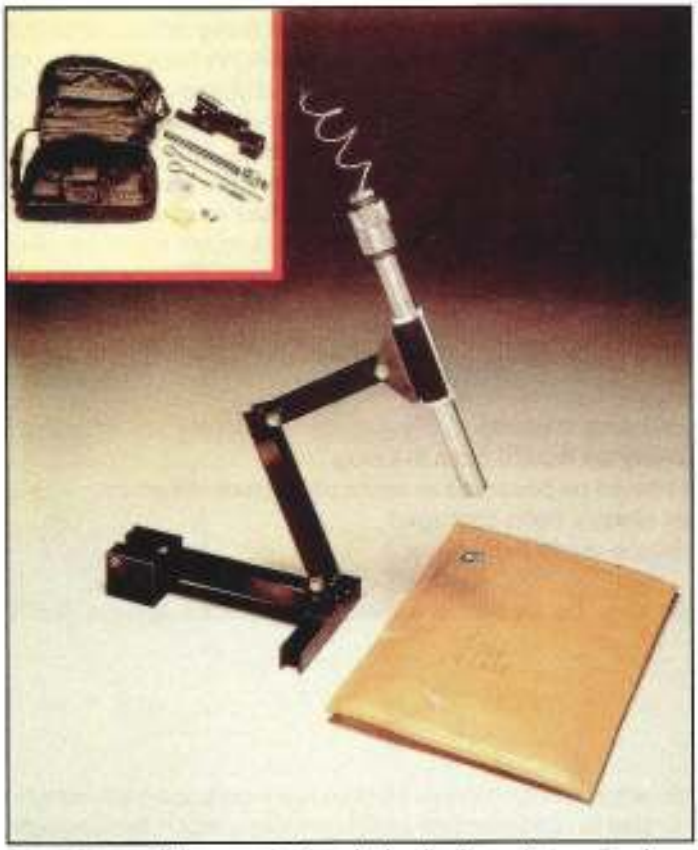
Older types of de-armer were generally secured using sandbags, while newer models tend to have purpose-built stands. Several models now incorporate reciprocating systems or muzzle brakes to reduce or completely eliminate recoil. Increasingly, the roles of de-armer and disruptor are being incorporated into a single weapon system. These weapons have parallel-sided bores, allowing them to accept a wide variety of liquid and solid shot. Steel slugs are available with various profiles to suit different applications, the most common being square ended, chisel pointed, broad bladed (often used for pipe bombs) and forked (to jam apart the components in certain types of fuze mechanism).

Notes

Successful use of a de-armer normally relies on the positive identification of the fuze and an appropriate RSP. See also the separate entry entitled *Disruptors* in this section.

A British 'Pigstick' disruptor being placed. Note the cable secured to the barrel and the terminals insulated using tape (PW Allen) 0074302

The Proparms mini disruptor is based on the .45 Long Colt cartridge, and will also fire .410 shot shells (Proparms Ltd) 0077479



'Needle' is a small disruptor, developed to be effective against small packages while preserving as much forensic evidence as possible. Inset is the complete equipment and carrying case (ABP) 0074303

The RE 70 M3 is a combined disruptor and de-armer, fired using a blank .50 cartridge (Colin King) 0572351

A modular disruptor, which can be fitted with different barrels (Colin King) 1042492

DISRUPTORS

Primary use

A disruptor is a remotely fired EOD weapon used primarily for the disablement of electrically initiated Improvised Explosive Devices (IED). In this context, the term 'disruption' means instant disassembly without causing initiation; this not only avoids unnecessary destruction, but also ensures maximum preservation of forensic evidence. Many of the newer designs can be used either as a disruptor or as a 'de-armer', to fire a solid shot. De-armers are covered in a separate entry.

Description

The basic components of a disruptor are a metal barrel, a screw-on breach block and an adjustable mounting stand. The barrel may taper internally towards the muzzle and must be sufficiently sturdy to withstand not only the internal pressures created by the propellant cartridge, but also the impact on hard surfaces that may result from recoil. Disruptors are usually initiated electrically, and the breach block may incorporate electric terminals for the connection of firing leads. Also needed are seals to enclose the shot (which is normally water), propellant cartridges and a means of initiation (such as firing cable and an exploder).

Operational details

Typical operation

The disruptor is normally prepared at the Incident Control Point (ICP). The first step is to insert the shot: in the British 'Pigstick', a gauge is used to push a cup-shaped plastic 'piston' into the barrel to the correct depth before water is poured in up to the level of the muzzle. The muzzle is then sealed with a small plastic cap to hold the column of water in place. With the disruptor fitted into the adjustable stand, an electrically initiated 'blank' propellant cartridge is inserted into the breach and the breach block screwed onto the barrel. The firing cable is then connected to the terminals on the breach. The EOD technician approaches the target manually, or with the weapon mounted on a Remotely Operated Vehicle (ROV), while the firing cable is paid out from a reel at the ICP. In order to maximise the chance of disrupting an electrical circuit, the weapon is normally positioned in line with the longest possible path through the target; optimum standoff is normally 20 to 30 mm. Where an X-ray or other detailed target information is available, the disruptor is generally aimed at the power source. The operator withdraws to the ICP, connects the power source and (having issued a suitable warning) fires the weapon.

Normal electric detonators have a 'bridge wire', which heats up when an electric current passes through it; when the wire is hot enough, it initiates the surrounding explosive compound. Disruptors work by physically breaking the electric circuit before the bridge wire becomes hot enough to initiate the device. The velocity of the water jet is sufficiently high that this will normally occur even if the fuzing system is initiated by firing the weapon.

In addition to disruption, the objective may be to displace the item, or simply a means of case entry, to gain access to internal charges and components.

EOD considerations

- For electrical initiation, radio frequency precautions should be observed to avoid premature initiation
- Disruptors should be afforded the same safety precautions as firearms
- Standard disruptors can recoil a substantial distance (unless firmly anchored)
- A disruptor may cause initiation of the target, particularly if primary explosive is struck
- Disruptors should not normally be used against mechanically-fuzed and other non-electric IEDs.

Variations

Although water is the most common fill for a disruptor, alternatives (such as gels or sand) can provide a means to vary penetration and range. Some designs incorporate reciprocating mechanisms or muzzle brakes that greatly reduce or eliminate recoil. Disruptors are routinely deployed on remotely controlled vehicle platforms to eliminate the need for a manual approach. Combined disruptor/de-armer systems are now available (see separate entry entitled *De-armers* in this section); these have parallel-sided bores to allow the use of various liquid and solid shot. Even more versatility is available with modular systems, which have interchangeable barrel assemblies, allowing different lengths, bores and nozzle options. The modular approach allows a single weapon system to be used as a disruptor or de-armer in a wide variety of EOD and IED disposal applications.

Notes

The penetration of a standard water-filled disruptor is limited to thin metal or a few millimetres of wood or hard plastic; soft casings can also significantly attenuate the force of the shot. The spread of shot means that there is a limit to the volume that can be attacked effectively. A single standard disruptor should not be used on anything larger than a small briefcase. In the UK, a range of disruptors has been developed to suit different target sizes and casings.

PE-4 plastic explosive (left) with detonating cord (above) and SX-2 sheet explosive (below) (Colin King) 0074740

Demonstrations of Shock Refraction Tape
(Explosive Developments Limited) 0074741

Dispensing 'NMX-FOAM' (formerly Lexfoam) foam explosive onto anti-personnel mines in Cambodia
(Colin King)
0074100

Placing a Liquid Explosive Pouch (LEP) on a mortar bomb in Cambodia
(Colin King) 0572355

Wedge-shaped demolition charges made from explosive recovered from Russian artillery projectiles. These charges are now used by demining organisations throughout Cambodia (Golden West) 1106920

EXPLOSIVES FOR EOD

Primary uses

In addition to demolition through sympathetic detonation, explosives may be used to overpressure, displace, disrupt, gain access to a structure, penetrate a munition casing or deflagrate the target.

Description

Most techniques use conventional high explosive that has been specially formed or incorporated into a shaped charge. Modern high-performance explosives based on RDX and PETN are most common because of their high velocity of detonation and detonation pressure. 'Plastic explosive' such as US 'C-4' or British 'PE-4' is supplied in sticks or slabs and can be moulded by hand into basic shapes. Plastic explosive is also available in sheet form for more specialised applications. Detonating cord is normally filled with PETN powder and waterproofed; some types are available in different weights (normally quoted in grams per metre), and the number of strands can also be varied to achieve the desired effect. Both conical metal liners (Munroe effect) and metal plates (Misznay Schardin effect) are used in specialist EOD shaped charges; these are covered in a separate entry in this section entitled *Low-order techniques*. Older linear-shaped charges tended to use pliable lead casings, but these have largely been replaced by non-metallic ribbon charges such as 'shock refraction tape' or 'explosive cutting tape'. These systems use the convergence of shock waves to shear a casing accurately along the desired line.

Operational details

Typical operation

For general demolition, bulk explosive should be placed on, or adjacent to, all munition components containing high explosive or propellant. The priority is to ensure complete destruction through 'sympathetic detonation' while minimising the possibility of unexploded ordnance or components being 'kicked out'. Sympathetic detonation means the successful propagation of the detonation wave from the donor charge to the target munition, such that both charges are destroyed. The proximity, direction of initiation and cross-sectional area of the donor charge are all critical to success, so it is normal to compensate for the variables by increasing its size well beyond the minimum estimated requirement. In most instances, the donor charge needs to be touching, or very close to, the target munition, which increases the risk of accidental movement and initiation; this is one reason for the popularity of 'stand-off' techniques (usually involving shaped charges).

The likelihood of successful demolition is substantially increased by enclosing (or partially enclosing) the donor charge with the target during detonation. This effect, known as 'tamping', can be achieved by placing munitions in a pit, or covering them with dense objects, such as filled sandbags or water bags. A significant tamping effect is produced by the resistance of the ground when a charge is placed on top of (rather than beside) a target on the surface. The benefits of tamping must be weighed against the dangers of moving or jarring sensitive unexploded munitions.

For 'case entry' applications, linear cutting charges, sheet explosive or carefully placed plastic explosive may be used to remove part of the casing and gain access to an explosive filling. To achieve this, precise amounts of explosive must be used and care must be taken to avoid fuze components and sensitive explosives. Detonating cord is sometimes suitable for the precise placement of small amounts of explosive, and can be used for disruption, separating components and gaining access (to car doors, for example). Once exposed, a munition filling can be removed or burned out using a flare (see *Incendiaries for EOD*). Low-order techniques, in which explosive is used to cause deflagration without detonation, are covered in a separate entry.

EOD considerations

- Care is needed to avoid 'kick-outs' during bulk demolitions
- Charges should be placed without moving or jarring sensitive, unexploded munitions
- During demolition, all explosive components must be attacked simultaneously
- Rocket venturis must be crushed during demolition to minimise the risk of launching the munition
- Fuzes, detonators and boosters should be avoided during case entry or low-order techniques
- The possibility of detonation must always be considered during case entry or low-order techniques.

Variations

EOD shaped charges can be improvised in the field, but will be less efficient and consistent than manufactured versions; this will make their results less predictable. Two-component paste, liquid and foam explosives have been developed for some specific demolition applications. The main advantages of such systems is that they can be shipped and stored as flammables, only becoming high explosive once mixed and dispensed. Foam explosive is versatile and achieves close contact with the target, but generally lacks the power to penetrate thick munition casings. It is ideal for most blast mines, where its low density and large surface area mean that it can be placed directly on the pressure plate or fuze, maximising the chances of demolition without risking accidental initiation. HE munitions, such as anti-tank mines, are often used as donor charges for bulk demolitions in post-conflict EOD operations.

Notes

Considerable training and practice is needed to achieve consistent results. Apparently similar targets may react differently to an explosive attack. See also *Low-order techniques* for more information on the use of explosives to induce deflagration.

An Allen hook and line set, with cable reels mounted on a box containing various accessories (Colin King) 0074203

Some of the accessories available for hook and line sets (Colin King) 0074204

HOOK AND LINE

Primary use

The hook and line set is one of the simplest yet most versatile tools available to the EOD technician. Although mainly used for remote handling during Improvised Explosive Device (IED) disposal operations, the set also has numerous applications in conventional EOD and demining. The hook and line set can be used to remotely initiate movement in order, for example, to gain access, withdraw a munition from a confined space or move it to a safe area, or to confirm the absence of anti-handling devices. Skilled operators can use hook and line sets to perform comparatively complex functions, such as opening car doors.

Description

Hook and line sets generally consist of a length of strong synthetic cord, a dispenser reel and a boxed set of ancillaries, including a variety of steel hooks, short lengths of cord and change-of-direction pulleys. The free end of the cord is normally fitted with a steel loop or spring clip. The reel normally has a handle and a brake to stop it from over-running and becoming tangled as it is fed out. Additional ancillaries may include specially shaped or double hooks, elastic cords, slings, clamps, suction pads, sections of rigid tube which screw together and pulling handles to allow the operator to exert more force on the line. Technicians often add other items to their own kits, such as gripping jaws, forceps, clips, adhesive tape and carabiners, based on their personal experience and procedures.

Operational details

Typical operation

The EOD technician will often identify the need for hook and line as a result of remote or close reconnaissance. An assortment of appropriate ancillaries is selected and carried by the operator. The reel normally remains at the Incident Control Point (ICP) and the line is fed out during the approach to the target. Change-of-direction pulleys are positioned where needed along the path of the line, and the system checked to ensure that the cord runs freely. At or near the target area, an appropriate ancillary is selected and fitted to the line; this is then attached to the target. If the technician is reluctant to touch the target item at all, a hook may be positioned so that it becomes attached as the cord is pulled. Returning to the ICP, the EOD technician then attaches pulling handles to the cord, if necessary, and pulls the line to initiate movement. Since the use of hook and line constitutes 'EOD action', a 'soak' time (pre-determined delay) should always be imposed. Where a line is used to pull a mine, or other object, out of the ground, a simple pivot (such as a log or building block) is used to create a lifting motion.

Although normally positioned manually, Remotely Operated Vehicles (ROVs) can also be used to attach lines to objects, where a simple linear movement is needed.

EOD considerations

- Care must be taken to ensure that the target is not moved prematurely
- If two lines are used, they must be clearly distinguished from one another
- There should be no tension on the cord during preparation and the operator must avoid snagging or tripping the line during his return to the ICP
- Firm control of the ICP is needed to ensure that the reel is not touched until preparation is complete
- Sensitive IEDs and munitions fitted with anti-disturbance devices may detonate when moved
- Movement using a hook and line set does not prove that an IED or item of UXO is safe to handle
- Movement may start an initiation sequence (hence the need for a 'soak' time after EOD action).

Variations

Since complex manoeuvres often require more than one line, some sets now incorporate two cable reels that can be dispensed simultaneously (see photograph). If two reels are being used, it is important to be able to distinguish between them; the use of different coloured lines is an obvious solution. The list of accessories offered by suppliers is constantly expanding and now includes many of the items (such as door stops, tripods and magnets), formerly improvised or added by individual operators. Other variations include lightweight sets in backpacks and heavy-duty kits for moving particularly massive objects, such as vehicles.

Notes

Setting up changes of direction can be complicated and extend the time spent in the danger area. The successful use of this system for anything other than simple tasks requires a substantial amount of training and practice.

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'Firaant' undergoing trials in the Republic of Srpska (Cliff Wright) 0056010

The Thiokol flare penetrates 1.5 mm of steel in less than 2 seconds (Colin King) 0074025

An anti-tank mine being burned out using the Mine Incinerator (SCPI)

0077205/0077206

A Thiokol flare set up against a live 82 mm mortar body (Colin King) 0074742

The results of successful deflagration, with the TNT fill ejected (Colin King) 0074743

INCENDIARIES FOR EOD

Primary uses

Incendiaries are mainly used to burn out explosive fillings from munitions. It is usually necessary to gain entry into a thick-walled munition before an incendiary can be used, but some are sufficiently hot to penetrate wooden, plastic and thin metallic casings, thereby eliminating the need for a separate case-entry operation. It is also possible to use incendiaries to induce deflagration in some types of metal-cased munition.

Description

The original EOD 'Destructors, Incendiary' were basically electrically initiated incendiary bomblets using a thermite filling and 'Electron' (magnesium alloy) casing. The short supply and expense of these items has lead to the development of several systems based on flares. These use a small tube (normally made from cardboard) with a pyrotechnic filling, and are initiated electrically using a squib. Some are supplied with simple stands, allowing them to be set up and aimed rapidly. A variety of thermite mixtures and packaging options have been tried, including bags of loose powder and domed cylindrical casings.

Operational details

Typical operation

The 'Destructor, Incendiary' is normally used to burn away the bulk explosive fill in a large munition, such as an aircraft bomb. Part of the casing is removed (using a low-order technique, explosive access, remote cutting 'trepanning' equipment or abrasive cutting equipment), the incendiary is then placed on the exposed explosive and initiated.

Flares are normally fitted to a stand, which is positioned so that the open end of the flare is a few centimetres from the target. When the electrical squib is initiated, the intense flame from the pyrotechnic composition is directed at the target by the surrounding tube (normally cardboard). The heat is normally sufficient to burn through thin casings, including steel around 1 mm thick. Once the casing has been penetrated, the explosive filling begins to burn; it will then continue to do so until it has been entirely consumed, even if the flare has finished burning. In most cases boosters will burn, but the detonator will normally explode once it gets sufficiently hot; when it does, any remaining explosive fill is also likely to detonate. In some applications, the casing is not actually penetrated, but becomes hot enough to induce deflagration; this will then split the casing open and may eject the explosive filling.

EOD considerations

- Large fillings take a long time to burn away and should not be approached until completely consumed
- Explosive may burn to detonation if confined
- Rocket motors may become propulsive if their propellant is ignited
- Fuzes, detonators and boosters should be avoided where possible
- The detonator and any residual explosive are likely to explode at some point when burning out an HE filling
- The possibility of complete detonation must always be considered.

Variations

Thermite can be used to ignite explosive fillings and, if suitably contained, can also penetrate steel casings. Thermite is a mixture of reactive metal powder and unreactive metal oxide, such as iron filings and copper oxide, and is normally available in the form of grenades or bags of loose powder. The device is normally placed on top of a munition so that the molten metal produced by the reaction helps to melt the munition casing and ignite the explosive filling. However, the intense heat generated by some mixtures has resulted in a high proportion of detonations; consequently, thermite is not favoured for low-order techniques. Trials have been conducted with commercial flares, such as those used for traffic control; initial results show that these can be effective in some applications.

The 'Dragon' flare is an interesting concept, as it is designed to be locally manufactured, wherever it is needed, from readily-available components. 'Dragon' is cheap to produce and requires minimal facilities and training.

Notes

Appropriate training and practice are needed to achieve consistent results. Apparently similar targets may react differently to incendiaries. See also separate entries on *Explosives for EOD* and *Low order techniques.*

'Vulcan' shaped charge, fitted with an optional water jacket
(Sidney Alford Ltd) 0074827

The results of a deflagration using 'Vulcan' against a Russian bomb in Afghanistan (CliffWright) 0529590

The SM EOD-33 is one in a range of small shaped charges that can be used to induce deflagration in thick-walled UXO
(Colin King)
0074739

Preparing to deflagrate a Yugoslav FAB-250 (M79) using an MS charge known as 'Baldrick'
(Colin King)
0074686

LOW-ORDER TECHNIQUES

Primary use

Low-order techniques are employed mainly as a rapid means of case-entry on larger munitions, where complete demolition is undesirable. The aim is to induce 'deflagration' within the explosive filling of a target munition, using this energy to tear open the casing. Deflagration is the partial explosion of the fill during a 'fast burn' that does not translate into a 'high-order' detonation.

Description

Most low-order techniques rely on a controlled explosive event to focus energy onto a target munition, although sufficient impact from an inert projectile can also be effective (see *notes*). Typically, a small HE charge is placed on or near a suitable point on the target; various types of charge have been used successfully, including Munroe effect shaped charges (generally known as High Explosive Anti-Tank, or HEAT), Misznay Schardin (MS) plate charges, linear shaped charges and standard military plastic explosive.

When plastic explosive is used, it is normally formed into sheets, discs or rings to suit the application and weapon configuration. The shaped charges used for low-order techniques are generally small and simple to use; they are normally supplied along with some form of adaptable stand to allow them to be set up with the correct stand-off distance. HEAT charges may contain only a few grams of explosive, while MS charges are normally slightly larger, containing perhaps 50 to 100 g. Most charges can be initiated, either electrically or by safety fuse, using a standard No 8 detonator.

Operational details

Typical operation

During low-order techniques, sufficient explosive is used just to breach or impact the casing to cause deflagration of the target munition's explosive filling without detonation. The point of attack must be carefully selected to achieve the optimum effect. To avoid detonation, it is essential to keep away from fuzes, primary explosive and boosters. It is also important to consider the casing thickness; a thin part of the casing may provide insufficient containment to allow adequate deflagration, while a thick section of casing may attenuate the shock sufficiently to prevent deflagration altogether. When fired, the jet of a HEAT charge or the plate of an MS charge penetrates the casing and enters the explosive filling to cause deflagration. However, it is not always necessary to penetrate the casing and explosive sheets or discs can often transmit sufficient shock through a metal-cased projectile or bomb to induce deflagration without actually breaching the body. If successful, the casing of the target munition is burst open to expose the HE filling; although deflagration is a violent explosive event, it produces substantially less energy than complete detonation, and most of the charge is usually left intact. In thick-walled munitions, the fragmentation effect can be reduced significantly or eliminated altogether. It is not unusual for the HE filling to be ignited during a low-order technique; this may then result in a complete and controlled burn, further deflagration, or complete detonation, as detonators and boosters are initiated.

EOD considerations

- There is always the possibility of detonation while attempting a low-order technique
- Sensitive munitions must not be moved during the placement of charges
- Fuzes, detonators and boosters should be avoided during low-order techniques
- Shaped charges, especially MS types, may have long down-range hazard areas
- The HE filling of the munition may be scattered over a considerable distance during deflagration
- HE fillings are sometimes ignited during deflagration, and may then burn to detonation some time after the initial event.

Variations

Since the charge must be appropriate to the casing thickness and munition size, some are manufactured in a range of sizes; these are normally explosive-filled and only require the emplacement of a detonator. Pre-filled charges have the advantage of being manufactured to high tolerances, which leads to more reliable and consistent performance. This is particularly important with HEAT charges, where poor filling can seriously degrade performance and accuracy.

Other shaped charges are supplied empty, or in component form, to be assembled and filled by the user. Not only does this avoid shipping, security and storage problems, it also permits the operator to assess the application and adjust the amount of explosive accordingly.

A further innovation, exemplified by the 'Vulcan' system, is a modular approach, which allows a variety of shaped charge liners or projectiles to be used (including copper, magnesium, aluminium). Vulcan also has a waterproof cone attachment to allow proper Munroe effect jet formation during underwater use.

It is possible to achieve deflagration using an incendiary rather than HE; see separate entry *Incendiaries for EOD* in this section.

Notes

Deflagration can be induced in some munitions using projectile attack with small-arms or cannon ammunition. This is now considered an accepted technique, particularly useful during combat operations. Some pyrotechnics, such as thermite, may also cause deflagration, however, the effects are unpredictable.

A mechanical fuze extractor, manufactured in the UK by Richmond EEI Ltd (Cliff Wright) 0074300

Components of the Richmond mechanical fuze wrench (Cliff Wright) 0074301

MECHANICAL FUZE WRENCHES

Primary use

The mechanical fuze wrench (sometimes known as 'Igol') is used for the remote removal of a threaded fuze, normally as part of a Render-Safe Procedure (RSP) for aircraft bombs. Use of a mechanical wrench may be specified where the action of a rocket wrench is deemed to be too violent.

Description

The mechanical fuze wrench is a simple tool that allows an EOD technician to unscrew an aircraft bomb fuze remotely. It pre-dates the rocket wrench (see separate entry) but, being simple and reliable, is still in production and available to EOD teams. Since it is less violent in operation than a rocket wrench, the mechanical fuze wrench is sometimes more appropriate for use against sensitive fuzes, such as those with all-ways acting mechanisms, and is specifically recommended in some RSPs.

A mechanical wrench consists of three major parts: a set of jaws to grip the fuze body, a pulling cable to allow the EOD technician to operate the mechanism remotely, and a reel to retain the pulling cable on the wrench assembly in storage. The cable reel has a wide diameter to create good leverage when the wrench is operated. Mechanical fuze wrenches usually incorporate a hammer mechanism within the reel assembly, allowing damaged, seized or tight fuzes to be loosened.

Operational details

Typical operation

Once the bomb fuze has been positively identified, the use of a mechanical fuze wrench will normally be specified in written RSPs. The wrench is removed from its transit case and prepared in a safe area to minimise the time spent in danger. The technician approaches the bomb with all the equipment necessary to fix the wrench into position and ensures that there is sufficient space available around the fuze to allow it to rotate freely. The need for adequate space will generally entail digging around the bomb. The pulling cable is paid out to the safe area and the jaws clamped on to a sturdy section of the fuze body (or in the position specified by the RSP), by adjusting bolts attached to the jaws. Care is needed to ensure that both jaws are adjusted evenly, so that the fuze is held centrally. The operator must also check to ensure that the wrench will give the correct direction of rotation when the cable is pulled, and that there are sufficient turns of cable on the drum to completely extract the fuze. Since the ideal pulling position is at right angles to the axis of the fuze thread, change of direction pulleys may be needed to lead the cable to a suitable safety point. Having withdrawn to the safe area, the operator makes a series of sharp pulls on the cable; this rotates the reel and functions the hammer mechanism to loosen the fuze. Once the fuze is free to turn, a sustained pull on the cable unscrews it from the fuze well.

EOD considerations

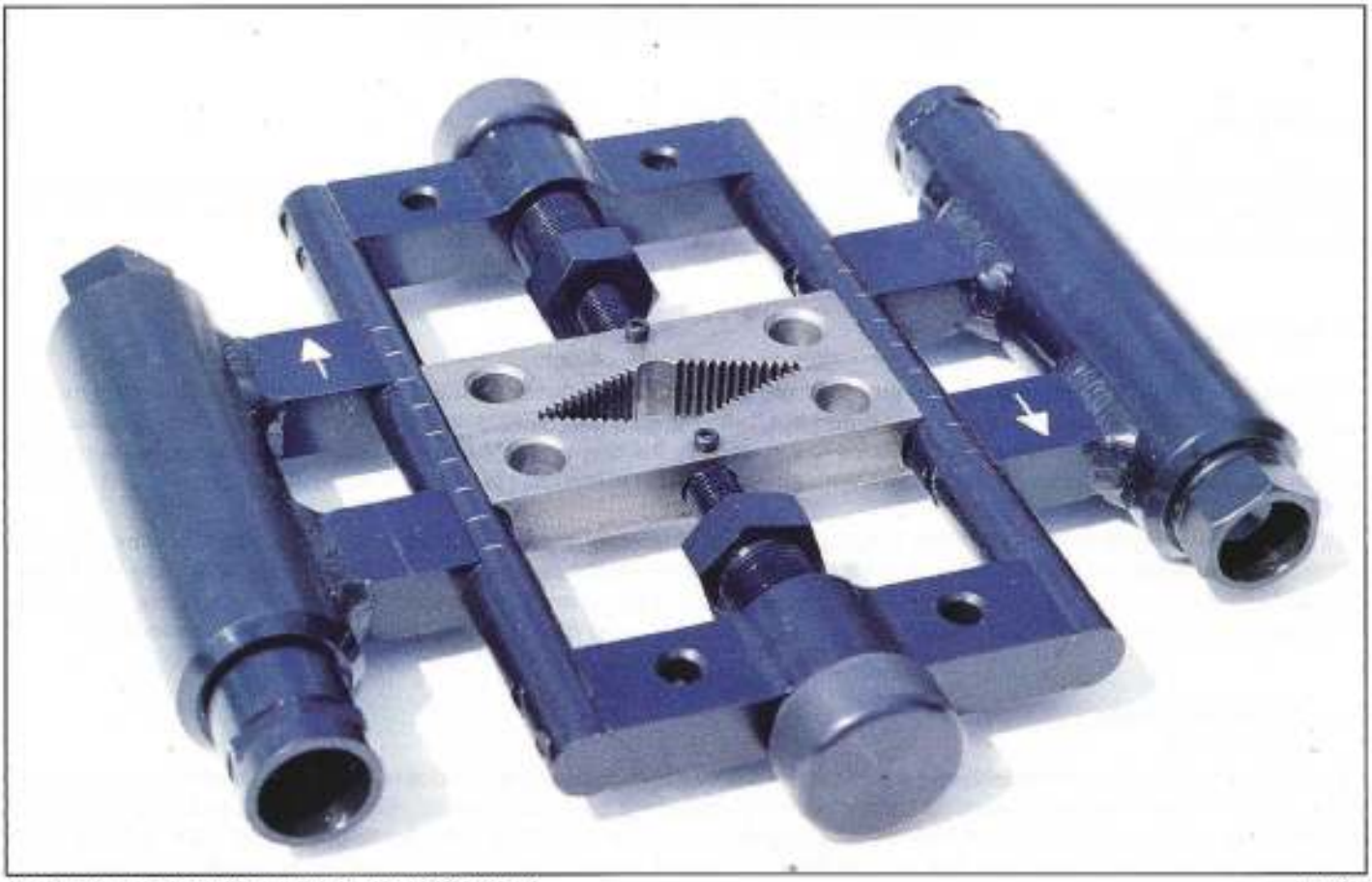
- Tightening the jaws onto a damaged or badly corroded fuze might be dangerous
- The hammer action may not effectively loosen badly corroded or damaged fuzes
- Remote operation is limited by the length of the pulling cable
- The safe area must afford sufficient protection from detonation of the bomb
- Correct preparation often requires the operator to be in the danger area for a relatively long time
- Time may be needed to clear an adequate working space around the fuze location.

Variations

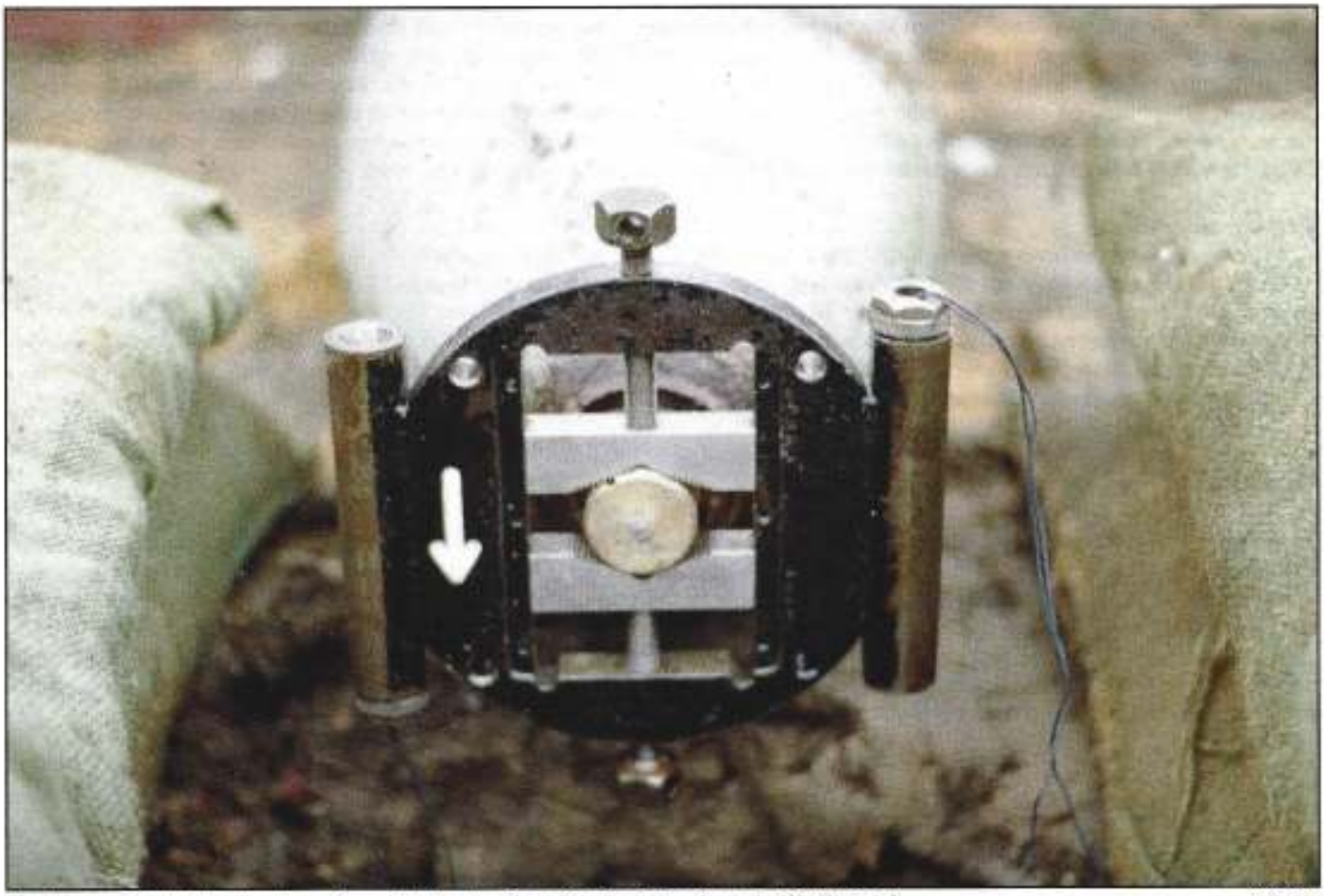
If the fuze is likely to be particularly difficult to unscrew, a large lever may be used to create additional torque; originally, a pipe wrench was used, but modern sets include a purpose-built lever. This is attached to the fuze and positioned perpendicular to the axis of pull, with the pulling cable attached close to the end of the handle. The cable from the mechanical wrench can be attached in such a way that it disengages from the pipe wrench once it has moved, allowing the mechanical wrench to function normally for the remainder of the fuze removal process. Two sets of jaws are normally available, to fit either parallel-sided or tapered fuze bodies. A mechanical lever may also be used in conjunction with a rocket wrench (see separate entry) to loosen a stubborn fuze before the rocket wrench is fired.

Notes

The effectiveness of the mechanical fuze wrench is well proven and basic versions were used extensively by EOD teams during the Second World War. Extending the cable or incorporating multiple changes of direction can significantly degrade the performance of the wrench, making it difficult to use with buried or awkwardly located munitions.



A rocket wrench, fitted with parallel-sided jaws (Cliff Wright) 0074298



A rocket wrench fitted to a bomb nose fuze. Note the direction of rotation is clearly marked (Cliff Wright) 0074299

ROCKET WRENCH

Primary use

Rocket wrenches are normally used for the remote removal of aircraft bomb fuzes as part of a Render-Safe Procedure (RSP).

Description

The rocket wrench is based around a rigid steel frame, which incorporates a set of adjustable gripping jaws to hold the wrench onto the fuze. The jaws are serrated to maximise their grip and adjusted by turning threaded bolts; final tightening is done using a spanner. The mid-point of the jaws is marked on the frame, with additional graduations to help the technician to keep the wrench centred on the fuze.

Cylindrical chambers are mounted on the outside edge of the frame and accommodate propellant cartridges, which provide the power to rotate the wrench. The chambers face in opposite directions; each is closed using a threaded plug, which incorporates a venturi to maximise the thrust from the burning propellant. Rocket wrenches are normally designed to use electrically initiated cartridges, the most common being based on the .50 inch calibre blank. The direction of rotation should be clearly marked on the wrench using arrows (see photographs).

Operational details

Typical operation

Once the fuze has been positively identified, the RSP will specify whether a rocket wrench is to be used and, if so, how it should be applied. To minimise the time spent in danger, the wrench is prepared for use in a safe area. The chamber plugs are unscrewed and the propellant cartridges inserted, with the electric leads protruding through holes in the plugs. The leads are connected in series to ensure that one cartridge cannot fire without the other. With the leads connected to a firing cable, the operator approaches the target and clamps the jaws firmly onto the fuze, taking care to ensure the correct direction of rotation and sufficient space for the assembly to rotate freely. This will generally entail digging around the bomb. Some technicians are also taught to attach bungee cords to the wrench, exerting a pull away from the munition; this is meant to help extract the fuze and pull the fuze free once the threads are fully disengaged, but often impedes the spinning action of the wrench. When fired, the propellant gases exit through the venturis facing in opposite directions on opposite sides of the wrench; this creates torque on the fuze to begin unscrewing it. This is a very rapid and violent, almost explosive, event. The inertia of the heavy frame ensures that the rotation continues briefly after the propellant has been burned, although more than one firing may be needed to fully extract a fuze that is damaged, seized or has a long thread. Since use of the rocket wrench constitutes 'EOD action', a 'soak time' (a pre-determined interval) should be allowed before any further manual approach is made.

EOD Considerations

- Flash from the propellant cartridges may ignite inflammable material near the target
- When using electrical initiation, radio frequency precautions should be observed to avoid premature initiation
- A rocket wrench may initiate a fuze, particularly if it has already been damaged
- Fuzes fitted with anti-withdrawal mechanisms are likely to be initiated
- Fuzes incorporating all-ways acting mechanisms are likely to be initiated
- The firing point must afford sufficient protection, should the bomb detonate
- Time may be needed to clear an adequate working space around the fuze location.

Variations

Two optional jaw sets are normally available, allowing the wrench to be fitted to either tapered or parallel-sided fuze bodies. Some versions allow optional initiation using detonating cord against the percussion cap of a conventional cartridge case. These may include a 'debulleting kit' as an accessory; this allows the bullets to be pulled from suitable ammunition, which are then crimped shut to create blank cartridges. For applications where a rocket wrench is considered too violent, an RSP may specify the use of a mechanical fuze wrench; this a manually-operated version of the rocket wrench (see separate entry). Mechanical assistance may also be used; this involves the connection of a long lever and remote pulling line to the rocket wrench, enabling a stubborn fuze to be loosened manually before the wrench is fired.

Notes

The rocket wrench cannot be used against transverse fuzes or those too big to fit the jaws (such as the MFBF). Damage to the fuze or casing, or excessive corrosion in the threads may prevent the wrench from being securely attached and operating effectively. Fuzes are not always removed at the first attempt and the removal of a stubborn fuze can be a time-consuming and frustrating process. A soak time must be applied after every firing, then the wrench may require repositioning; it must be reloaded, rewired into the circuit and the circuit tested before each subsequent firing.

The CHRONOS electronic stethoscope (telerob) 0120893

Components of P W Allen's electronic stethoscope set (telerob) 0074284

Components of the EBEX 2001 electronic stethoscope set, which allows remote monitoring by a second operator (SDS Group Ltd) 0074327

STETHOSCOPES, ELECTRONIC

Primary uses

Stethoscopes are normally used to identify the presence of an active mechanical timer, or to monitor a device in which a mechanical timer might become reactivated. They are used for both conventional EOD (mainly for clockwork bomb fuzes) and for Improvised Explosive Devices (IEDs).

Description

A kit consists of one or more sensors, with fittings (which usually includes clamps and magnets) to allow rapid and secure attachment to the target. A probe may also be available; this allows an inaccessible target (such as a buried bomb) to be monitored before it has been fully uncovered. The signal is relayed to a battery-powered control box, either through a length of cable or via a radio transmitter. In the control box, the signal is processed, amplified and reproduced through a loudspeaker or a set of headphones. Some sets allow the operator to monitor the signal close to the target during a manual approach, while also permitting remote monitoring from a safe distance.

Operational details

Typical operation

The EOD technician prepares the equipment at the Incident Control Point (ICP), a safe location away from the target. This typically includes selecting the type of sensor (contact or stand-off – see *variations* below) and then fitting an attachment device, if necessary. During the operator's approach to the target, a stand-off sensor may be used to identify any sign of an active mechanical timer. With a bomb or underwater weapon, the contact sensor is normally secured to the target, although a magnet should not be used if there is any possibility that an influence fuze may be present. The operator will continue to monitor the device for the duration of the manual approach, with a second operator listening from the ICP; this provides a back-up in case the operator has to cease monitoring, is distracted or there is significant background noise. Clearly, the second operator must be in communication with the first in order to pass on a warning of any suspicious sound from the target. Unless the operator is convinced that there is no threat from a mechanical timer after the first approach, the stethoscope will normally remain in position and monitoring will continue throughout the procedure. It will only be removed, on the final approach, if a destructive technique is to be used. In some situations, such as where an IED is thought to contain a mechanical timer, it may be possible to emplace a contact sensor using a Remotely Operated Vehicle (ROV).

EOD considerations

- Contact fixtures must be positioned with care
- Fixtures should be positioned so as to not interfere with subsequent EOD action
- Magnets must not be used where an influence fuze may be present.

Variations

Stand-off sensors (which do not need to be in contact with the target) are incorporated into modern stethoscope sets (see photographs). These are normally hand-held and use a Doppler shift microwave sensor, capable of detection behind or through solid non-metallic materials, such as wood and even brickwork. The control box may incorporate signal processing options to allow background noise to be filtered out or certain frequencies to be enhanced.

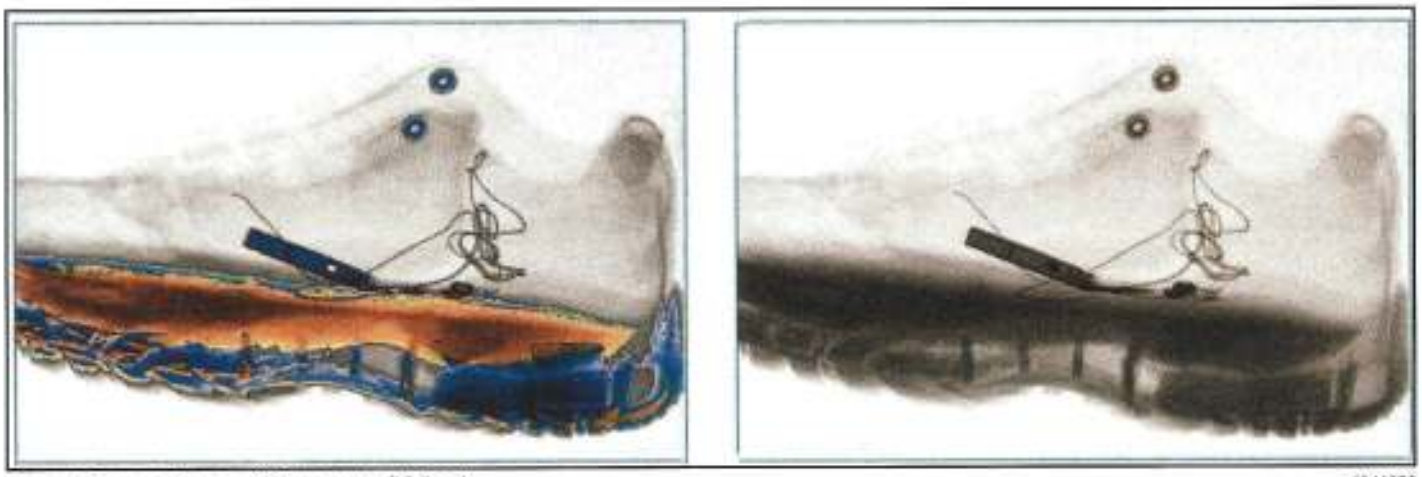
Notes

Stethoscopes were widely used during the Second World War, where some German bombs were fitted with long delay clockwork fuzes. These fuzes had a tendency to stop shortly before initiation and could be re-started by a sudden jolt or vibration. Conventional (medical) stethoscopes were used at first, and gradually replaced by electronic versions that allowed greater sensitivity and remote monitoring.

The 'Inspector' portable X-ray source, viewed from the back. This older version is still in service with countries around the world (Colin King) 0074267

The film developer used with 'Inspector'. Wet film has now been largely replaced by electronic sensors sending real-time images to TV or LCD screens (Colin King) 0074268

A modern real-time portable X-ray system, using a laptop for image processing (Vidisco) 0129199



Images from a dual-energy X-ray system (Vidisco) 1041268

X-RAY INSPECTION

Primary uses

X-ray inspection is used primarily on suspect packages to confirm or discount the presence of an Improvised Explosive Device (IED), weapons or ammunition. If an IED is present, inspection may be used to provide information about its internal make-up, such as the type and location of critical components. X-ray may also be used on items of conventional ammunition; applications include locating internal components, establishing whether or not ammunition in poor condition is live, and confirming whether or not a fuze is armed. Although it is rarely used in the field, the use of X-ray is routine for captured or unknown munitions before being broken down or analysed.

Description

Portable X-ray equipment normally consists of three components: an X-ray source, a sensor to capture the X-rays passing through the target and a means to develop or interpret the X-ray pattern. For fixed installations, these elements may be combined into a single unit. Most portable equipment uses a compact electronic X-ray generator, which can be controlled to suit different target thickness and material. This is normally done in one of two ways; by varying the length of exposure, or by setting the number of pulses from an X-ray generator. Within the limitations of the source's power, the thicker and denser the target material, the longer the exposure or the greater the number of pulses required. Older portable systems use 'wet' Polaroid film, placed in a special cassette, to capture the image; this requires a special developing unit to process the exposed film. More modern systems use an electronic X-ray receiver that can transmit images directly back to a screen at the Incident Control Point (ICP).

Operational details

Typical operation

The EOD technician prepares the equipment at a safe location away from the target. This typically includes setting the correct number of pulses on the X-ray generator and preparing the receiver or film cassette. On approach, the X-ray generator is placed on one side of the target, and the receiver or film cassette on the other, at the appropriate distance and attitude to receive the X-rays within the projected beam. Once the equipment has been positioned, the technician withdraws and the source is operated, either by remote control or by a timer. With a 'wet film' system, a second approach is then needed to retrieve the film. Back in the ICP, the X-ray sensitive film is developed or the transmitted image analysed for subsequent action. Good X-ray images can convey a great deal of information, such as the exact location of internal components, type of circuitry and size of charge. A good image of an IED is particularly useful if a disruptor is to be used, since the weapon should be aimed at a power source or wiring, while avoiding explosives and other components as much as possible.

EOD considerations

- There is a downrange hazard from the X-rays that are generated
- Permanent radioactive sources present a storage hazard and are subject to the normal precautions for working with radioactive materials
- Ionising radiation can initiate some sensitive primary explosives
- Ionising radiation can have unpredictable effects on electronic circuitry and could cause initiation
- Although extremely unlikely, the possibility of an IED having been designed for initiation by X-rays should be considered.

Variations

For particularly thick-walled or large items, permanent, radioactive (gamma-ray) sources are sometimes used, though these require greater safety, security and maintenance measures. Real-time electronic imaging systems may allow selective magnification and other digital enhancement of images to aid analysis; multiple images may be taken, stored, transmitted to a remote location for analysis, or printed. Although X-ray images tend to appear in 'grey scale', most modern fixed installations also allow the use of false-colour to discriminate between substances with distinct physical properties, such as metals and organic compounds. The colours, corresponding to the attenuation of different wavelengths or energy levels, are generated within the imaging system and displayed on the operator's screen. This facility is now available in portable equipment, allowing field operators to differentiate between materials. Other options include the ability to vary the grey scale contrast or view the negative image.

Notes

Limitations of portable systems include:

- the need to accurately estimate the number of pulses or exposure required for different targets when using wet film
- the need for a clear space on two opposite sides of the target to place the X-ray source and sensor
- difficulty positioning equipment using a remotely operated vehicle (ROV); a manual approach is usually needed.

IDENTIFICATION

Colour Codes

General
NATO colour codes
NATO chemical colour codes
US chemical colour codes
Obsolete Russian bomb colour codes
Small Arms Ammunition

Markings

Explosives markings
NATO ammunition markings
NATO small arms ammunition markings
NATO special symbols
Russian ammunition designators
Russian ammunition markings
Russian projectile markings
Russian ammunition packaging
Russian high explosive designators
Russian propellant designators
Russian pyrotechnic and chemical fill designators
US weapon designations
US rocket and missile designations
Cyrillic and Latin transliteration table
Yugoslav ammunition markings
Yugoslav ammunition terms and designators
Yugoslav fuze designators
Yugoslav HE terms and designators
Yugoslav propellant and pyrotechnic designators

Explosives

Commercial high explosives
'Home-made' explosives
Military high explosives
Solid propellants
Liquid propellants

Colour codes are a useful aid to identification, but must be interpreted with care. In the NATO system, yellow markings would signify high explosive, but on this Yugoslav KB-1 submunition they denote 'practice'. This bomblet has an inert fill, but a live detonator (Colin King) 0074224

Many national colour codes have changed over the years; these British 2 inch mortar bombs bear pre-NATO colour codes in which HE is marked with red and green bands (Colin King) 0572350

The different shades of these 107 mm rockets help to identify their origin. Those on the far left and right are Russian, the darker green rocket in the centre is Iranian while most of the others are Chinese (Colin King) 0573808

Yugoslav ammunition often has this light green background with yellow lettering (Colin King) 0532016

Olive green paint on a Chinese mortar bomb (Colin King) 0074713

Russian green-brown paint on a TM-83 mine (Colin King) 0066185

The 'olive drab' (OD) used on most US land service ordnance (Colin King) 1121167

A ZAB-500 bomb painted in the characteristic grey used on many Russian munitions (Colin King) 0573258

COLOUR CODES

GENERAL

Colour codes offer a simple and effective means of identifying the filling or function of a munition, and have been used by most ammunition manufacturers at some time or another. However, simplification and refinement of colour codes, together with the need to accommodate new ammunition types, has led to a succession of changes within national marking systems. Many countries have now adopted the NATO colour codes defined with Standard NATO Agreements (STANAG 2321); these are listed in a separate entry.

Background colours

For munitions in relatively good condition, the colour and even the shade of the paint can be a clue as to the origin. For example, while most countries paint their land service ordnance green, Russian ammunition is often grey. With experience, different shades of green can sometimes be identified; for example, the shade used on Yugoslav ordnance tends to be significantly lighter than the US 'olive drab' which, in turn is noticeably different from the 'deep bronze green' of many other NATO munitions.

Although not definitive, background colour can be a useful aid to identification in combination with other marking practices.

Warning

Colour codes should never be relied upon in isolation, especially for the identification of older ordnance. Inconsistencies and ambiguities can be misleading, even where the category, age and nationality of a munition is known. Some of the shades are similar and may fade or discolour with time, heat, or exposure to chemicals; among unexploded ordnance, colours such as bright red, dark red and brown sometimes become indistinguishable.

There are several marking practices specific to munition categories or roles, and a colour that is 'non-significant' in one can be 'significant' in another. For example, black is used as a background colour on some underwater munitions, but signifies 'armour-defeating' on land-based ordnance. There is further potential for confusion with chemical and phosphorus-filled munitions. A dark green band, for example, normally denotes a toxic agent, but has been used on some Yugoslav HE projectiles.

In summary, while colour codes can provide the EOD technician with a convenient aid to identification, it is always wise to look for supplemental identifying features or markings.

Examples of NATO colour codes. The rockets have brown motors (denoting propellant) and blue tips (indicating that these are practice warheads). Below the warheads are two grenade bodies with yellow markings and hazard bands (denoting high explosive) on a deep bronze green 'insignificant' background. Above and to the right are two BL-755 submunition warheads; these also have yellow bands to denote high explosive, but have black bodies, and a 'significant' background to convey that they are armour-defeating munitions (Colin King) 0074223

The red band on a light green background with yellow lettering is an officially recognised NATO marking for White phosphorus (Colin King/DEODS) 0074650

The yellow background of this 40 mm grenade indicates HE, while the black colour used for the lettering is 'non-significant' (Colin King) 1042494

The HEAT warhead of an 84 mm Carl Gustav round. The yellow lettering signifies HE while the black 'significant' background denotes the armour-defeating role. Note also the red letter 'T' to indicate the presence of a tracer element (Colin King) 1042493

A South African 155 mm HE frag projectile marked according to NATO codes, with yellow on a 'deep bronze green' background (Colin King) 1279553

NATO COLOUR CODES

This entry lists the colour codes currently in use under the Standard NATO Agreement (STANAG 2321), for ammunition above 30 mm calibre. Although these are NATO codes, international trade in ordnance has also led to their adoption by several non-NATO countries. For colour codes relating to ammunition of 30 mm calibre and below, see the entry *Small arms ammunition colour codes* in this section.

'Significant' and 'non-significant' colours

Colours which denote a munition filling or function are known as 'significant', while other colours are termed 'non-significant'. Significant colours are generally used for hazard bands and stencilled markings, but may also be used for backgrounds. For example, where yellow markings appear on an olive green NATO projectile, the yellow indicates the presence of high explosive while the green is an 'insignificant' background colour. However, where yellow markings appear on a black NATO projectile, the background is also 'significant' (in this case indicating that the projectile is armour-defeating).

Warning

Although colour codes are a convenient aid to recognition, they should not be relied upon in isolation for EOD purposes. Particular care is needed when the age or nationality of the munition is uncertain; prior to the NATO system, a variety of codes were used, with many variations over the years. Bright red, for example, was often used to denote high explosive in older systems, while it now signifies an incendiary filling. A green central band on old British HE ammunition sometimes indicated an Amatol filling, but now denotes either smoke or toxic agent. Yellow, denoting high explosive under the NATO system, signifies 'practice' or 'chemical agent' on munitions manufactured in the former Yugoslavia. Different shades may also become lighter or darker with age, and certain colours can be either significant or non-significant, depending on the munition type (see tables).

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SIGNIFICANT COLOURS

Colour	Filling/purpose	Notes
White	Illuminating	Including coloured lights Sometimes non-significant (see table below)
Grey	Chemical agent	Used as background colour for chemical agents, which may include riot agents. Sometimes non-significant (see table below)
Silver	Countermeasures	Such as chaff and propaganda Non-significant if unpainted metal
Black	Armour-defeating	Sometimes non-significant (see table below)
Brown	Low explosive	Including Black Powder (gunpowder)
Light red	Incendiary	May include liquids, gels and tracer compositions. Not to be confused with dark red, which denotes a chemical filling (see *NATO chemical colour codes*)
Dark red	Riot control agent	See *NATO chemical colour codes*
Yellow	High explosive	A band may indicate the presence of an HE component
Light green	Smoke/screening	Including Phosphorus
Light green with red markings	White phosphorus	An unofficial colour code adopted by Belgium, France and the UK. The same colours, with an additional yellow band, are used by Denmark, Germany, Netherlands, Norway and the US
Light green with yellow and light red	White phosphorus	White Phosphorus may be marked, officially, with: a light green body, light red band and yellow markings; or light green body, yellow band and light red markings
Dark green	Toxic agent	On grey background. See *NATO chemical colour codes*
Blue	Practice/training	May have additional bands to denote explosive content
Purple (band)	Incapacitating agent 'BZ'	See *NATO chemical colour codes*
Violet (stripes)	Experimental	

NON-SIGNIFICANT COLOURS

Colour	Notes
White	Generally, non-significant as markings, on underwater munitions, missiles, rockets and dispensers. Can also be significant (see table above)
Grey	Generally, non-significant on underwater munitions, missiles, rockets and dispensers. Can also be significant (see table above)
Dark grey	Always non-significant
Black	Generally, non-significant as markings or on underwater munitions. Can be significant as a band or background colour (see table above)
Green	Generally non-significant on underwater munitions
Deep bronze green	Always non-significant
Green, infra-red reflective	Always non-significant
Olive drab	Always non-significant
Unpainted	Always non-significant

NATO CHEMICAL COLOUR CODES

The following colour codes are currently in use throughout NATO for chemical munitions under Standard NATO Agreement (STANAG) 2321. In every case, the overall colour of the munition should be light grey, with coloured bands to denote the filling. Additional coloured hazard bands may be present to denote other functions or fillings, such as yellow to indicate the presence of HE or brown for low explosive burster charges; see *NATO colour codes*.

Colour and number of bands	Filling/purpose	Persistency	Example agents
Red (1 band)	Riot agent	non-persistent	CN, CS
Dark green (1 band)	Blood and choking agents	non-persistent	AC, CK
Dark green (2 bands)	Blister agents	persistent	HD, HN, L
Dark green (3 bands)	Nerve agents	persistent and non-persistent	GA, GB, VX
Violet/purple (1 band)	Incapacitating agents	persistent	BZ

Markings on a US Mk 94 bomb with a GB (Sarin) fill. The yellow band indicates the presence of HE (Colin King) 1279562

A CS grenade, marked with a single red band to indicate riot agent (Colin King/DEODS) 0074652

US CHEMICAL COLOUR CODES

US MIL STD 709

The following colour codes have been used by the US for chemical munitions under US Military Standards 709A, B and C. The background colour of the munition is grey. Most of the current US chemical colour codes conform to those used by NATO, with additional coloured bands used to signify other functions or fillings, such as yellow to indicate the presence of HE or brown for low explosive burster charges; see *NATO colour codes*. See also *Chemical agent designators*.

Marking	US MIL STD 709A	US MIL STD 709B (STANAG 2321)	US MIL STD 709C (revised 1976)
Approximate effective date	Prior to 1964	1964 — 1976	From 1976 onwards
Red (1 band)	Persistent and non-persistent incapacitating agents	Non-persistent incapacitating agent	All riot control agents
Red (2 bands)		Persistent incapacitating agent	
Green (1 band)	Non-persistent casualty agent	Non-persistent casualty agent	All casualty agents
Green (2 bands)	Persistent casualty agent	Persistent casualty agent	
Green (3 bands)		All nerve agents	
Yellow band		High explosive component	High explosive component
Brown band		Low explosive component	Low explosive component
Purple band			Incapacitating agent BZ

OBSOLETE RUSSIAN BOMB COLOUR CODES

The table shows the colour codes that were generally used on Second World War era Russian bombs. The background (non-significant) colour for most Soviet bombs was dark grey, although the propaganda bomb 'AB' was green overall. Other markings originally stencilled onto bomb bodies included weight, fuze type and filling, while tail sections were generally marked with the year of manufacture, lot number and factory number.

Modern Russian bombs generally use stencilled markings instead of colour codes; for more information see separate entry *Russian Federation bombs* in the *Types of unexploded ordnance* section.

Warning

Variations in Russian colour codes are known to exist, and these markings should not be relied upon for identification. With these older bombs, other indicators of function should be considered in conjunction with any visible colour codes; these include size, shape, casing material and thickness, and fuze location.

Obsolete Russian Bomb Colour Codes

Nose band colour	Body band colour	Cyrillic designation	English	Function
None	None	ФАБ	FAB	General Purpose (HE)
Green	Blue	АО	AO	Fragmentation (HE)
Green	Green and blue	АОХ	AOKh	Fragmentation (Chemical)
Orange	None	БРАБ	BRAB	Semi-armour- piercing (HE)
Blue	None	БЕТАБ	BETAB	Armour-/concrete- piercing (HE)
Red	Blue	ЗАБ	ZAB	Incendiary
None	Red	ЗАБ	ZAB	Incendiary cluster
Red	Green	ХАБ	KhAB	Chemical — persistent
Green	Green	ХАБ	KhAB	Chemical — non-persistent
None	Yellow and green	КРАБ	KRAB	Toxic smoke
White	White	САБ	SAB	Parachute flare
Blue	Black	РС/ДС	RS/DS	Rocket-assisted
Red	White			Practice

SMALL ARMS AMMUNITION

Introduction

Small arms ammunition and cannon rounds between 20 and 30 mm calibre are normally colour coded by painting the body and/or tip of the projectile. In the past, the cap annulus (the junction of the primer cap and the cartridge case base) has been coloured, and although this practice continues, it is no longer a primary method of identification. In most cases the colour has no significance, being added to the waterproofing varnish simply to make inspection easier. Stencilled markings may also be present in 'significant' colours to denote the role.

Cartridge cases may be coated or chemically treated to enhance performance or inhibit corrosion, especially those made from steel, which tend to be lacquered. The colour of the cartridge case is not normally significant, except in the case of plastic blank ammunition, some of which is blue to signify its practice function. Inert 'drill rounds' are often plated to give a polished silver finish, with indents in the side of the case painted red.

20 mm cannon ammunition. Variations in national marking practices can make it difficult to identify the role using colour codes alone (Colin King) 1340665

A selection of US .50 calibre rounds, showing a combination of NATO, US pre-NATO and developmental colour codes. Types, from the left are: (Bob Leiendecker) 1374549

1. Ball;
2. High Pressure Test (tinned case);
3. High Explosive Incendiary (yellow over blue tip);
4. Long Range Tracer (red over blue tip);
5. Spotter Tracer (yellow over red tip);
6. Observation (yellow tip);
7. Armour Piercing Incendiary Tracer (blue over red tip);
8. Armour Piercing Incendiary Tracer (red over silver tip);
9. Armour Piercing Incendiary (early multipurpose round; green over white);
10. Target Marker (green tip);
11. Incendiary (light blue tip);
12. Armour Piercing (black tip);
13. Armour Plate Test (silver over black tip);
14. Armour Piercing Incendiary (light blue over silver tip);
15. Armour Piercing Incendiary (silver tip);
16. Incendiary (dark blue over light blue tip);
17. Duplex (green tip)
18. Target Marker (blue tip);
19. Armour Piercing (British contract; green tip);
20. Armour Piercing Incendiary (multipurpose; green over silver tip);
21. Armour Piercing Tracer (red over black tip);
22. Tracer (maroon tip);
23. Tracer (red tip);
24. Tracer (orange tip);
25. Armour Piercing (light red, almost pink tip);
26. Armour Piercing Incendiary (multipurpose; light green tip)

Several nations produce ammunition for export to both NATO and non-NATO countries, and vary the markings accordingly; others manufacture under license. Together with historic changes, individual national colour codes and a number of inconsistencies, this can make it difficult to identify the role of small arms and cannon ammunition from colour codes alone.

Argentina

Small arms ammunition

Black tip	AP
Red tip	Tracer

20-30 mm ammunition

Black	AP
Black body, yellow ring over red ring at tip	SAP-HE-I
Blue	TP
Grey body, yellow ring over red ring around nose	HE-I

Australia

All natures

NATO standard

Austria

All natures

NATO standard, plus one national code:
Purple bullet tip
Sniper ball

In the following identification tables, colours are listed in alphabetical order, and their meaning given using the abbreviations below.

AP	Armour Piercing	SAP	Semi-Armour Piercing
APDS	Armour Piercing Discarding Sabot	SE	Secondary Effect
HE	High Explosive	T	Tracer
I	Incendiary	TP	Target Practice /Training Practice

Belgium

Small arms ammunition

NATO standard

20-30 mm

Black with red band	AP-I
Light blue	Practice
Yellow	HE
Yellow with red band	HE-I

A 25 × 137 mm cannon practice round (Colin King) 1042495

Brazil

All natures

US pre-NATO system (see US)

Canada

All natures

NATO standard

China

Small arms ammunition: 7.62 mm — 14.5 mm

NOTE: Chinese ammunition colour coding changed in 1967. Designations marked 'old', are pre-1967.

7.62 × 39 mm cartridges

Black tip, black primer annulus	AP-I, Type 56 (current)
Black tip, red band	AP-I, Type 56 (old)
Green tip	Tracer, Type 56
None	Ball, Type 56

7.62 × 54R Cartridges

Black tip	AP-I, M1953 (current)
Black tip, red band	AP-I, Type 53 (old)
None	Ball, Type 53 (current)
White or silver tip	Ball, Type 53 (mild steel core) (old)

14.5 mm API ammunition in Iraq (Colin King) 0558427

12.7 × 108 mm cartridges

Black tip	AP-I, Type 54 (current)
Black tip, red band	AP-I, Type 54 (old)
Violet tip	API-T, Type 54 (current)
Violet tip, red band	API-T, Type 54 (old)

14.5 × 114 mm cartridges

Black tip	AP-I, Type 56 (current)
Black tip, red band	AP-I, Type 56 (old)
Red tip	Incendiary-T, Type 56

Czech Republic

Small arms ammunition

Russian Federation system, plus two national codes:

Green tip over white band	Observing
Yellow tip	Incendiary

Denmark

All natures

NATO standard

Egypt

All natures

Russian Federation system

Finland

Small arms ammunition

Black tip over red ring	AP-I
Blue bullet tip	AP

In the following identification tables, colours are listed in alphabetical order, and their meaning given using the abbreviations below.

AP	Armour Piercing	SAP	Semi-Armour Piercing
APDS	Armour Piercing Discarding Sabot	SE	Secondary Effect
HE	High Explosive	T	Tracer
I	Incendiary	TP	Target Practice / Training Practice

Red bullet tip	Observing
White bullet tip	Tracer
Yellow bullet tip	Incendiary

France

Small arms ammunition

Black bullet tip	AP
Black tip over red ring	AP-T
Blue bullet tip	Incendiary
Blue tip over red ring	Incendiary-T
Red bullet tip	Tracer
Silver bullet tip	AP-I
Silver tip over red ring	AP-I-T
Yellow bullet tip	Observing
Yellow tip over red ring	Observing-T

20-30 mm

Black body with red over yellow rings	SAP-HE-I
Black with red markings	APDS
Blue	TP and TP-T
Yellow	HE
Yellow with red ring	HE-I

20 mm HE-I MG-151 ammunition with Hexal HE filling (Colin King) 0568428

Germany

Small arms ammunition

NATO standard

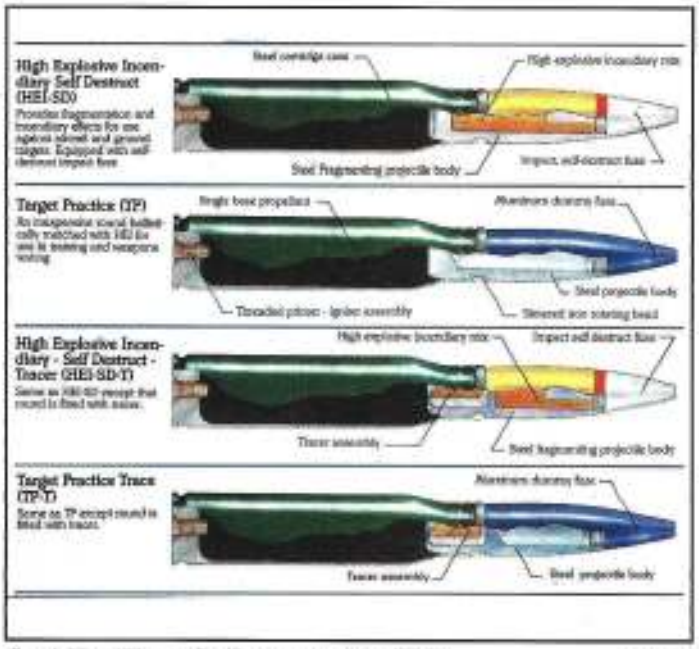
20-30 mm

Black with red lettering	AP-T
Black with white lettering	AP
Black with yellow lettering	AP-HE
Blue	TP
Yellow	HE

Greece

All natures

NATO standard


High Explosive Incendiary Self Destruct (HEI-SD)
Target Practice (TP)
High Explosive Incendiary - Self Destruct - Tracer (HEI-SD-T)
Target Practice Trace (TP-T)

Greek 30 × 170 mm Oerlikon ammunition (EBO) 0084894

Hungary

All natures

Russian Federation system

India

All natures

NATO standard

Israel

Small arms ammunition

Black bullet tip	AP
Blue tip over black ring	AP-I
Blue tip over black ring over red ring	AP-I-T
Red bullet tip	Tracer

Italy

All natures

NATO standard

In the following identification tables, colours are listed in alphabetical order, and their meaning given using the abbreviations below.

AP	Armour Piercing	SAP	Semi-Armour Piercing
APDS	Armour Piercing Discarding Sabot	SE	Secondary Effect
HE	High Explosive	T	Tracer
I	Incendiary	TP	Target Practice /Training Practice

Japan

All natures

NATO standard

Jordan

All natures

NATO standard

Korea, North

All natures

Russian Federation system

Korea, South

All natures

USA pre-NATO standard (see USA)

NATO

Small arms ammunition

No colour	Ball
Black bullet tip	AP
Blue bullet tip or dark/light blue	Incendiary

NATO 7.62 mm ammunition. From the left: ball, plastic-cased blank, tracer, drill round, metal-cased blank (Colin King) 0536447

20 mm cannon ammunition with NATO markings (Colin King) 1279527

Blue plastic casing	Blank (no bullet)
Green	Heavy ball or duplex
Green with white ring	Frangible ball
Orange bullet tip	Tracer (dark ignition)
Red bullet tip	Tracer
Red tip over white or silver ring	AP-I-T
Silver or white bullet tip	AP-I
Yellow bullet tip	Observing
Yellow tip over red ring	Observing-T

20-30 mm

Black body, red lettering	AP-I
Black body, red lettering	APDS-T
Black body, red lettering, red ring	AP-I-T
Black body, white lettering	APDS
Blue body	TP
Blue body, red ring	TP-T
Yellow body	HE
Yellow body, red lettering	HE-I
Yellow body, red lettering, red ring	HE-I-T

Netherlands

All natures

NATO standard

Despite being manufactured in the Netherlands, this 20 mm M56A3 HE-I round has been marked using the French colour coding system (Colin King) 0074637

In the following identification tables, colours are listed in alphabetical order, and their meaning given using the abbreviations below.

AP	Armour Piercing	SAP	Semi-Armour Piercing
APDS	Armour Piercing Discarding Sabot	SE	Secondary Effect
HE	High Explosive	T	Tracer
I	Incendiary	TP	Target Practice /Training Practice

New Zealand

All natures

NATO standard

Norway

All natures

NATO standard

Poland

All natures

Russian Federation system

Portugal

All natures

NATO standard

Romania

All natures

Russian Federation system

Russian Federation

5.45 × 39 mm cartridges

Black tip, green band	Ball, reduced velocity
Green tip	Tracer
None. Red lacquer seal	Ball, mild steel core
None. Violet lacquer seal	SAP
White plastic bullet	Blank

7.62 × 25 mm cartridges

Black tip, red band	AP-I
Green tip	Tracer
None	Ball, lead core, Type P
None	Ball, steel core, Type PST

7.62 × 39 mm cartridges

Black tip, green band	Ball, reduced velocity
Black tip, red band	API, Type BZ
Green tip	Tracer, M1945
None	Ball, steel core
Red tip	Incendiary-T

Russian 5.45 mm ammunition. From the left: tracer, ball with mild steel core, blank; note the lacquered steel cases (Colin King) 0536446

7.62 × 54R mm

Black tip, red band	AP-I, M1932
Green tip	Tracer, M1946
None	Light ball, M1908
Red bullet, black tip, black cartridge base	AP-I, M1940
Red tip	Incendiary-T
Silver tip	Light ball, steel core
Violet tip, red band	API-T
Yellow tip	Heavy ball, M1930

9 × 18 mm

None	Ball, lead core, Type P
None	Ball, steel core, Type PST
None, conical ogive	Ball, high velocity, Type PM

12.7 × 108 mm

Black tip	AP, M1930, Type B-30
Black tip, red band	AP-I, M1932, Type B-32
Green tip, indentations in case	Duplex round
Red bullet	HE-I, Type MDZ
Red bullet, black tip, black primer	AP-I, M1941, Type BS-41
Violet tip, red band	AP-I-T, Type BZT
Violet tip, red band	AP-I-T, M1944, Type BZT-44

14.5 × 114 mm

Black tip, red band	AP-I, M1932, Type B-32
Red bullet	HE-I, Type MDZ
Red bullet, black tip, black primer	AP-I, M1941, Type B-41
Red bullet, violet tip	AP-I-T, Type BST
Red tip	Incendiary-T, Type ZP
Violet tip, red ring	AP-I-T, Type BZT

In the following identification tables, colours are listed in alphabetical order, and their meaning given using the abbreviations below.

AP	Armour Piercing	SAP	Semi-Armour Piercing
APDS	Armour Piercing Discarding Sabot	SE	Secondary Effect
HE	High Explosive	T	Tracer
I	Incendiary	TP	Target Practice /Training Practice

20-30 mm

White tip or band	Inert practice
Yellow tip (black projectile)	AP-I-T
Magenta tip (black projectile)	HE-I-T
Blue tip	Airburst target practice
Red band	Incendiary
Green tip	Blank or inert practice
Green fuze	Inert fuze

Saudi Arabia

Small arms ammunition

Green bullet tip	AP-T
Orange bullet tip	Incendiary
Purple bullet tip	AP

Serbia

All natures

Mainly Russian Federation system. Ammunition manufactured for export may have NATO colour codes.

Yugoslav cannon ammunition (Colin King) 1279628

Singapore

All natures

NATO standard

South Africa

All natures

NATO standard

Spain

All natures

NATO standard

Sweden

Small arms ammunition

Ammunition under 20 mm calibre is identified by a coloured bullet tip or body.

Tip colour	Body colour	Type
Black (5-8 mm)	Unpainted	AP
Black (15 mm)	Unpainted	AP (tungsten core)
Orange	Unpainted	Incendiary
Unpainted	Unpainted	Ball
White	Yellow	HE-T
White (15 mm)	Unpainted	Tracer
Yellow	Yellow	HE

Ammunition in calibres over 20 mm can be identified by a combination of projectile body colours and colour bands. Basic projectile body colours are:

Body colour	Type
Black	AP, AP-HE
Red	SAP
Yellow (below 60 mm)	HE

Canister, HE, smoke, incendiary and illuminating projectiles may be grey, unpainted, or have a special surface treatment.

Colour bands around the centre of the projectile indicate effect, as follows:

Colour band	Type	Notes
Black	AP	Secondary capability
Light grey	Smoke	
Orange	Incendiary	
Yellow	HE	Not used when base colour is yellow

The following letter codes may also be present to indicate the projectile filling:

A	Amatol (TNT/AN)
E	RDX/TNT
F	White phosphorus
GRKT	Fragments
H	RDX
K	Black powder
LYS	Illuminating
N	Trinitroanisol
R	Acid smoke
RSV	HEAT
ST	Steel balls
T	TNT
Z	RDX/TNT/aluminium

Switzerland

Small arms ammunition

Red base of cartridge case	AP
Violet base of cartridge case	Tracer

20-30 mm

Pink projectile body	Incendiary
Red projectile body	Tracer

In the following identification tables, colours are listed in alphabetical order, and their meaning given using the abbreviations below.

AP	Armour Piercing	SAP	Semi-Armour Piercing
APDS	Armour Piercing Discarding Sabot	SE	Secondary Effect
HE	High Explosive	T	Tracer
I	Incendiary	TP	Target Practice /Training Practice

A Swiss HE-I cannon projectile (Colin King) 1279629

Yellow and pink projectile body (approximately half and half)	HE-I
Yellow projectile body	HE

Syria

All natures

Russian Federation system

Taiwan

All natures

US pre-NATO standard (see US)

Turkey

All natures

NATO standard

United Kingdom

Small arms ammunition

NATO standard

20-30 mm

NATO standard, with one addition for 30 mm RARDEN cannon ammunition:

Black body with green ring	AP-SE

United States

All natures

NATO standard.

However, before the adoption of the NATO colour codes in 1957, the following markings were used. These systems are still used by some of the countries that were supplied by the US, including Brazil, South Korea and Taiwan.

Small arms ammunition

Black bullet tip	AP
Blue bullet tip	Incendiary
Brown bullet tip	Tracer (dark ignition)
Dark blue tip over light blue ring	Incendiary (.50 Browning)
Green bullet tip	Duplex ball
Green tip over white ring	Frangible ball
Red bullet tip	Tracer
Red bullet tip over silver ring	AP-I-T
Silver bullet tip	AP-I
Yellow tip over red ring	Observing-T

20-30 mm

Black	Practice ball
Black with white lettering	AP
Dark blue	HE-T (Pentolite)
Grey	HE-T (TNT)
Grey	TP
Grey with yellow ring	TP-T
Pink	HE-I (Pentolite)
Red	HE-I (TNT)
White	HE (TNT)
Yellow	HE (Pentolite)

A selection of 7.62 × 51 mm ammunition, showing NATO, US pre-NATO and developmental colour codes. From the left, these are: (Bob Leiendecker) 1374690

1. Ball;
2. Tracer (orange tip);
3. Armour Piercing (black tip);
4. Armour Piercing Incendiary (silver tip);
5. Incendiary (light blue tip);
6. Tracer (red tip);
7. Frangible (green over white tip);
8. Low Recoil Ball (white tip);
9. Starlight tracer (green over pink tip);
10. Dim Tracer (green over white tip);
11. Tracer (white over pink tip);
12. Tracer (pink tip);
13. Duplex (green tip);
14. Tracer (red over white tip);
15. Observation (yellow tip)

Vietnam

All natures

Russian Federation system

In the following identification tables, colours are listed in alphabetical order, and their meaning given using the abbreviations below.

AP	Armour Piercing	SAP	Semi-Armour Piercing
APDS	Armour Piercing Discarding Sabot	SE	Secondary Effect
HE	High Explosive	T	Tracer
I	Incendiary	TP	Target Practice / Training Practice

Yugoslavia, former

Most ammunition produced for the export market was marked according to the Russian or NATO systems (see separate entries).

Cannon ammunition

Black	AP
Yellow	HE
Green band	Tracer
Red band	Incendiary

A Yugoslav 20 mm M57 HE-I round. The tracer version has an additional green band
(Colin King)
1340867

In the following identification tables, colours are listed in alphabetical order, and their meaning given using the abbreviations below.

AP	Armour Piercing	SAP	Semi-Armour Piercing
APDS	Armour Piercing Discarding Sabot	SE	Secondary Effect
HE	High Explosive	T	Tracer
I	Incendiary	TP	Target Practice /Training Practice

MARKINGS

EXPLOSIVES MARKINGS

The following markings may be seen on explosive packaging, explosive or munition storage areas and vehicles transporting ammunition or explosives. Although they may also be placed on ammunition packaging, they are not normally seen on the munitions themselves. The symbols (sometimes with minor variations) are virtually standard throughout NATO and have been adopted by a wide variety of international organisations; these include the United Nations, the European Union and the International Maritime Organisation. A number of non-NATO countries have also adopted these markings, particularly those with a significant production capability and trade in ammunition and explosives.

CLASS

Hazard classes include the following:
- Explosives (of all types)
- Gases
- Flammable liquids
- Flammable solids
- Oxidising materials, including Organic Peroxides
- Toxic or infectious substances
- Radioactive materials

TEXT

The word 'EXPLOSIVE' is usually written in English, but may appear in other languages. There are a number of national variations, such as 'BLASTING AGENTS' (sometimes used in the United States), 'SAFETY EXPLOSIVE', 'UK MILITARY EXPLOSIVE' and so on. Text is often omitted altogether on transportation markings and may also be absent on individual munition labels.

SYMBOL

The explosive symbol shown opposite is typical of the type used by the UN and throughout NATO for explosives in divisions 1.1, 1.2 and 1.3, although a number of minor variations exist. The symbol is not normally used with explosives in divisions 1.4, 1.5 and 1.6.

BACKGROUND

The background colour is normally orange, although a red background is sometimes used (in the Balkans, for example). Other hazard classes use different symbols and background colours, a red background normally indicating a fire hazard. The symbol and other markings are normally in a diamond shape, although a square background is used by some transportation organisations.

DIVISION

Explosive divisions denote the basic characteristics of a munition or substance.

1.1	Mass explosion hazard
1.2	Projection hazard, but no mass explosion hazard
1.3	Fire and minor blast or projection hazard, but no mass explosion hazard
1.4	No significant hazard
1.5	Insensitive explosives with a potential mass explosion hazard
1.6	Very insensitive explosives with no mass explosion hazard

COMPATIBILITY GROUP

Compatibility groups denote the nature of an explosive substance or munition filling, and state whether a means of initiation is present. This information is particularly relevant to the safe storage and handling of the item.

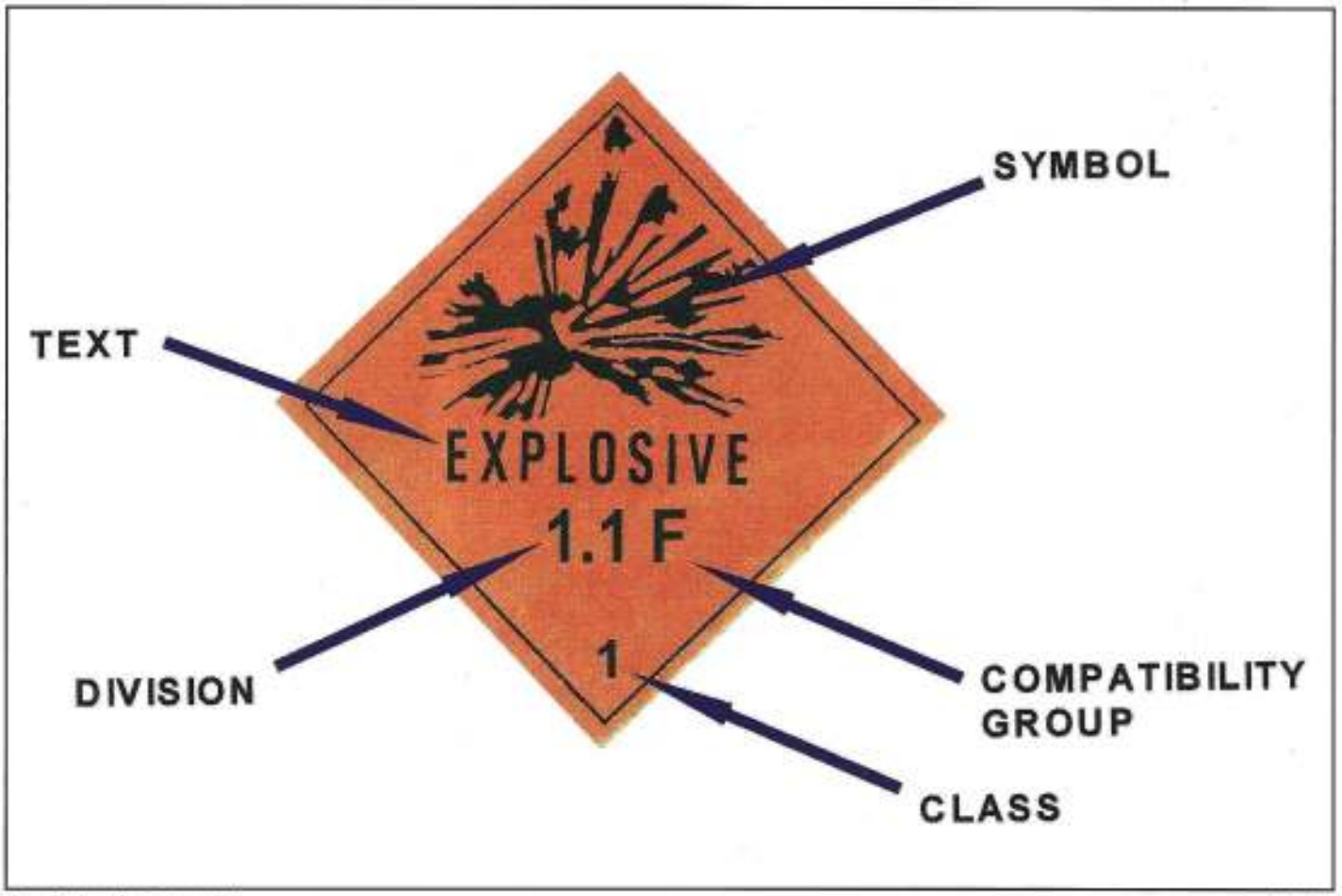
Letter	Description
A	Primary explosive
B	Item containing primary explosive
C	Contains propellant or secondary deflagrating explosive
D	Secondary explosive or black powder, with no means of initiation or propelling charge
E	Secondary explosive with no means of initiation, but with a propelling charge
F	Secondary explosive with a means of initiation, either with or without propelling charge
G	Pyrotechnic substance or munition
H	Contains explosive and white phosphorus
J	Contains explosive and flammable liquid or gel
K	Contains explosive and a toxic chemical agent
L	Special risk, requiring isolation from other explosives
N	Contains very insensitive explosive
S	Packaging designed to contain the initiation of contents

Despite being manufactured in the Former Federal Republic of Yugoslavia, this demolition charge bears a 1.1D NATO explosive classification. This denotes secondary explosive with a mass explosion hazard, but no means of initiation (Colin King) 0074222

This commercial label shows only the hazard class (Colin King) 1041002

A typical sign on a building containing explosives (Colin King) 1279630

Demolition charges, without means of initiation, bearing a 1.1D classification (George Zahaczewsky) 1374198



A typical explosive symbol 0074133

Roland missile tubes in Iraq
(Colin King)
1374199

Typical NATO markings on an HE projectile
(Colin King) 1330114

Typical NATO markings on a HESH projectile. The yellow denotes HE while the black background signifies an armour-defeating role
(Colin King) 1121272

Markings on an illuminating mortar round. The white background denotes the role, as does the parachute symbol (Colin King) 1121274

NATO AMMUNITION MARKINGS

MARKINGS

The photographs show typical markings for NATO artillery projectiles and mortar bombs. Ammunition calibre, type and filling are normally given according to the abbreviations listed in the table below. The exact format of the markings varies between different countries and manufacturers and a role indicator (such as M for mortar or H for howitzer ammunition) is not always present. See also *NATO colour codes* and *NATO special symbols*, which are listed in separate entries.

ABBREVIATIONS

The following abbreviations are widely used by UN and NATO countries. They may be encountered on packaging, and on the munitions themselves, as part of a designation or associated information. Some words (such as 'INERT', 'SHELL' and 'MINE') are normally written in full and are therefore not listed here.

Chemical agent and explosive abbreviations and designations are covered in separate entries. Other abbreviations used for the description of ammunition are contained in the Glossary.

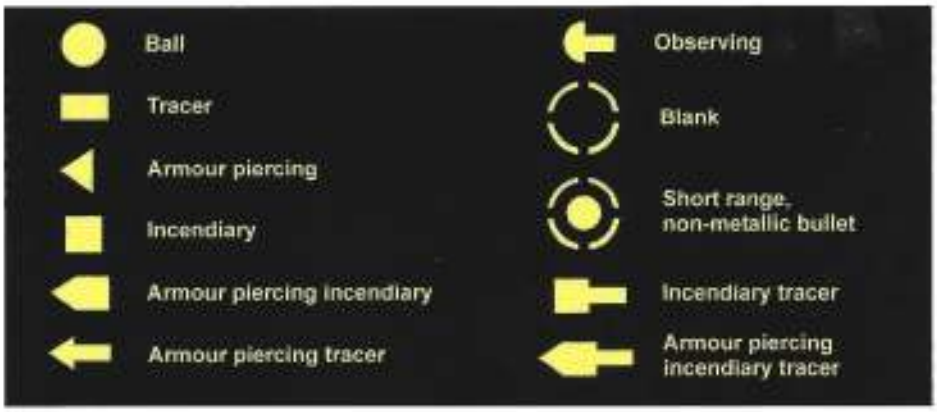
Abbreviation	Meaning
A RIOT	Anti-riot
AA	Anti-aircraft
AMMO	Ammunition
AP	Armour-piercing
APC	Armour-piercing capped
APDS	Armour-piercing discarding sabot
APFSDS	Armour-piercing fin-stabilised discarding sabot
APERS	Anti-personnel
API	Armour-piercing incendiary
APSE	Armour-piercing secondary effect
AS	Anti-submarine
At or ATK	Anti-tank
B HIV	'Beehive' demolition charge
BANGTORP	Bangalore torpedo
BB	Base bleed
BD	Base detonating
BE	Base ejecting
BMLT	Bomblet
BU	Break-up
CAN	Candle (pyrotechnic) or Canister ammunition
CART or CTG	Cartridge
CE	Composition exploding (Tetryl)
CG	Centre of gravity
CHG or CHGE	Charge
CLSTR	Cluster
CNSTR	Canister
CNTCT	Contact
DB	Double-base (propellant type)
DEM	Demolition
DESTR	Destructor
DET	Detonator/detonating
DP	Dual purpose
DSCHR	Discharger
ELEC	Electric
ER	Extended range
ERFB	Extended range full bore
F DEV	Firing device
FD	Field gun ammunition
FLAR	Flare
FRAG	Fragmentation/fragmenting
FS	Fin-stabilised
FUZ	Fuze
FZD	Fuzed
GEN	Generator (pyrotechnic)
GM	Guided missile
GP	General purpose or Gunpowder
GREN	Grenade
H	Howitzer ammunition
HB	Hollow base

Abbreviation	Meaning
HC	Hollow charge
HE	High explosive
HEAT	High explosive anti-tank
HEDP	High explosive dual purpose
HEI	High explosive incendiary
HEIT	High explosive incendiary tracer
HESH	High explosive squash head
HV	High velocity or Hypervelocity
ILLUM or ILL	Illuminating
INCDY	Incendiary
INFLU	Influence
INIT	Initiator
INST	Instantaneous
INSTRUCT	Instructional (training aid)
IRRT	Irritant
LE	Low explosive
LPA	Liquid propellant actuated
M	Mortar ammunition
MOR	Mortar
MP	Multipurpose or Metal piercing
MT	Mechanical time (fuze type)
MTR	Motor
NE	Nose ejecting
PD	Point-detonating
Phos	Phosphorus
PIBD	Point-initiating base-detonating
PE	Plastic explosive
PRAC	Practice
PRIM	Primer
PROJ	Projectile
RAP	Rocket-assisted projectile
RE	Radio Echo
RKT	Rocket
SAA	Small arms ammunition
SB	Single-base (propellant type)
SD	Self-destruct
SER	Serial
SHRAP	Shrapnel
SMK	Smoke
SPA	Solid propellant actuated
SS	Spin-stabilised
SUB	Substitute
SUPP or SUPPL	Supplemental
T	Tracer
TK	Tank ammunition
TP	Target practice/training practice
VOL	Volume
WHD	Warhead
WP	White phosphorus
WT	Weight

NATO SMALL ARMS AMMUNITION MARKINGS

Bullets

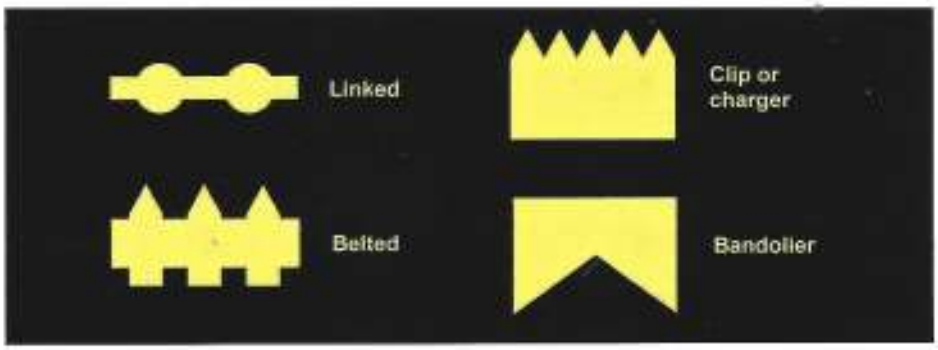
The following symbols are used to depict bullet types on NATO packaging for Small Arms Ammunition (SAA). Where ammunition is in a belt, figures may be used to show the number and sequence of bullet types (such as 4 ball followed by 1 tracer).



NATO symbols for SAA bullet types
(Colin King)
1374235

Packing

The way in which the ammunition is packed within the box is shown using the following symbols. Figures may also be used to show the number of rounds in the belt, clip or bandolier, or the number of clips in each bandolier.



NATO symbols for SAA packaging
(Colin King)
1374236

A box of NATO SAA showing typical markings
(Colin King)
1374237

NATO SPECIAL SYMBOLS

Weight zone markings

Weight/mass zone marks indicate how much the ammunition varies from the standard weight for that item. The marks may be in either a single or double row; they are normally placed near the nose of a projectile and may also be marked on packaging. Note that the marks have been stamped into the casing at the foundry, then stencilled in yellow when the shell was painted. Weight zone symbols are normally in a 'significant' colour (for example, yellow on a projectile filled with high explosive) but have no other relevance to EOD.

Weight zone markings
(Colin King)
1041003

Symbol used for inert instructional aids

The 'INERT' marking indicates that the munition is completely Free From Explosive (FFE), normally for demonstration or instructional purposes. Inert munitions must contain no energetic material of any kind, and should not be confused with practice ammunition, which may be hazardous. Note that in one example image the marking is shown in white on a 'significant' blue background, however both the marking and background colour may vary. Thus an inert munition may be marked in the colour codes of live ordnance, for instructional purposes (as in the other image). Such munitions are generally marked with 'INERT INSTRUCT'.

An inert instructional projectile in the colours of a live munition (Colin King) 0572352

Symbol used for inert munitions
(Colin King)
1041004

The symbol of interchangeability may appear in any colour, and indicates that the ammunition conforms (in dimensions, performance and service) to a model approved by NATO. When the symbol is shown inside a box, this indicates that it applies to all items within the package.

Interchangeability symbol
(Colin King)
1374194

Smoke colour designator

This symbol is normally seen on smoke-producing munitions and indicates a colour effect. The 'C' letters are printed in the colour of the effect, usually on a 'significant' colour background, such as light green for smoke.

Smoke colour designator
1121273

Radar echo symbols

Either of these symbols may be used to indicate a Radar Echo effect. The symbols may vary slightly between manufacturers and are normally in silver on a non-significant background, or black on a silver background.

Radar echo symbol
(Colin King)
1329652

Alternative radar echo marking
(Colin King)
1329653

Storage and transportation temperature marking

This marking shows the temperature limitations for the storage and transportation of munitions. It is normally marked on packaging but may also be placed on some munitions (such as missiles). The line of the box may be broken.

Storage and transportation temperature marking
(Colin King)
1374195

Usable temperature marking

This symbol shows the extremes of temperature under which the ammunition may be fired. It may be found on both munitions and packaging. The line of the circle may be broken.

Usable temperature marking
(Colin King)
1374196

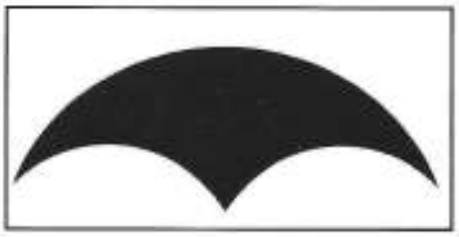
Design mark

This mark indicates that ammunition meets an approved NATO design.

Design mark
(Colin King)
1374197

Parachute symbol

This symbol indicates that the ammunition incorporates a parachute. It is normally marked in white or black on illuminating carrier munitions.



Parachute symbol
0074148

Single flare marking

A star indicates a pyrotechnic signal. A white star on a non-significant background, or black star on a white background, indicates an illuminant or white light. A coloured star indicates a single light source of the colour shown. A number may be placed beside the symbol to indicate multiple flares of the same colour.

Single flare marking
0074149

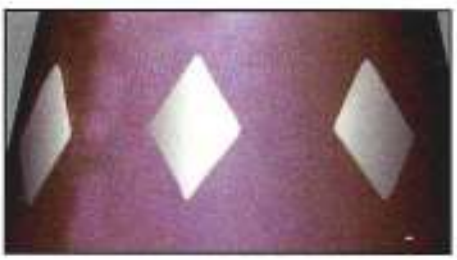
Multiple flare marking

Two stars indicate separate lights in the colours shown; the upper star will be the first colour to be ejected. Numbers, or 'MULTI' may be placed beside the stars to indicate multiple flares of that colour.

Multiple flare marking
0534038

The symbol used to denote a payload of flechettes

A band of white diamond shapes around a munition indicates that it is loaded with flechettes (small darts, normally made from steel). The diamonds may be outlines or solid colour.



The symbol used to denote a payload of flechettes
(Colin King)
1279631

The symbol used to denote a payload of scatterable mines

A band of yellow triangles around a munition denotes a payload of scatterable mines. The triangles may be outlines or solid colour.

The symbol used to denote a payload of scatterable mines
(Colin King)
1279632

The symbol used to denote a payload of submunitions

A band of yellow diamonds around a munition denotes a submunition payload of HE bomblets. The diamonds may be outlines or solid colour.

The symbol used to denote a payload of submunitions
(Colin King)
1279633

Embossed colour codes

On items such as signal flares, colours may also be denoted using embossed shapes, which can be read in the dark by touch, according to the following code:

Dot or Line: white
Cross: red
Triangle: green
Circle: yellow

An embossed marking on a white signal flare
(Colin King)
1041005

RUSSIAN AMMUNITION DESIGNATORS

The following markings may appear together with other letters and figures in designations on Russian and other former Warsaw Pact ammunition. Great care should be taken when interpreting markings, since the same letter may have several meanings when used in different contexts. Weapon designations are also dependent on configuration; for example, a missile may be given a different designation when it is in a container.

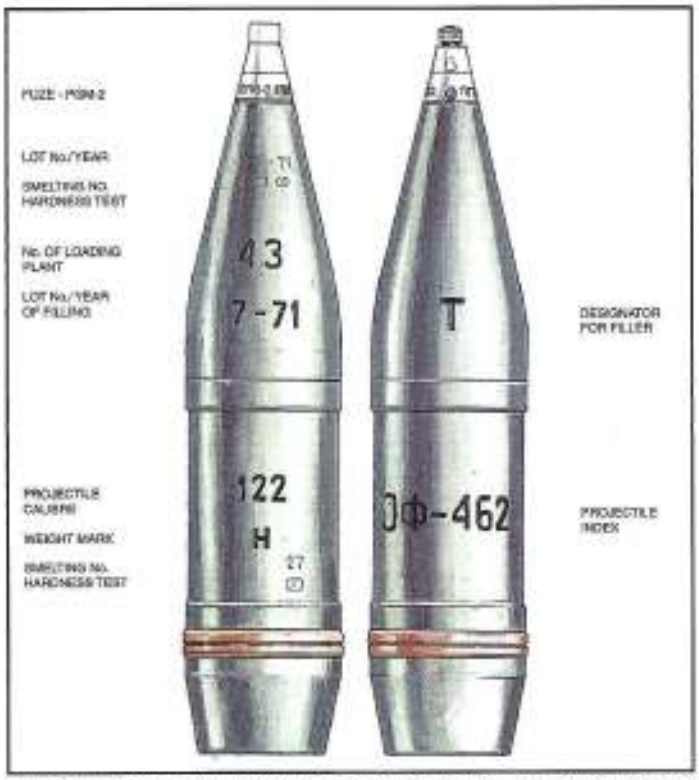
See separate entries for fill designators and other markings.

Cyrillic designation	English	Usual meaning
ЗД	3D	As a prefix: pyrotechnics
7Н/7П	7N/7P	As a prefix: small arms ammunition
9Б	9B	As a prefix: battery
9Д	9D	As a prefix: Motor
9Э	9E	As a prefix: fuze or fuze component (for example Piezo element)
9Ф	9F	As a prefix: simulator
9К	9K	Whole system
9Х	9Kh	As a prefix: pyrotechnic element (for example Tracking flare)
9М	9M	As a prefix: munition designation (for example 9M22U rocket)
9Н	9N	As a prefix: warhead or projectile designation
9П	9P	As a prefix: launcher, or component, or system
9В	9V	As a prefix: test unit or apparatus
9Я	9Ya	As a prefix: box or crate/packaging
А	A	Fragmentation or propaganda
Б	B	Armour-piercing
БК	BK	High explosive Anti-Tank (HEAT) — fin-stabilised
БМ	BM	Armour-Piercing Discarded Sabot (APDS)
БП	BP	HEAT — spin-stablised
БР	BR	Armour-piercing tracer
БЗ	BZ	Armour-piercing incendiary
БЗА	BZA	Armour-piercing incendiary — improved
БЗР	BZR	Armour-piercing incendiary tracer
Д	D	Smoke
ДЦ	DTs	Smoke — target marking
Ф	F	High explosive (HE)
Г	G	Concrete-piercing
ИНЕРТ	INERT	Contains no harmful or hazardous material
Х	Kh	Chemical
М	M	As a suffix: modified version of munition or system
МАКЕТ	MAKET	Model
О	O	Fragmentation
ОФ	OF	Fragmentation HE
ОФР	OFR	Fragmentation HE tracer
ОФЗТ	OFZT	HE incendiary tracer
ОГ	OG	Fragmentation grenade — rocket propelled
ОР	OR	Fragmentation tracer
ОСКОЛ	OSKOL	Fragmentation
ОЗ	OZ	Fragmentation incendiary
ОХ	OKh	Fragmentation chemical
ПБР	PBR	Armour-piercing — target practice
ПГ	PG	HEAT grenade — rocket propelled
ПРАКТ	PRAKT	Practice (Note: not necessarily inert)
ПУ	PU	Target practice
Р	R	Tracer
РПО	RPO	Infantry rocket: 'flame weapon' or fuel-air explosive
С	S	As a prefix: electronic component or launcher
С	S	Illuminating
СП	SP	Solid shot, armour-piercing
Ш	Sh	As a prefix: optical sight unit or component
Ш	Sh	Fragmentation
Щ	Shch	Canister
У	U	Training
Я	Ya	Box or crate
З	Z	Incendiary

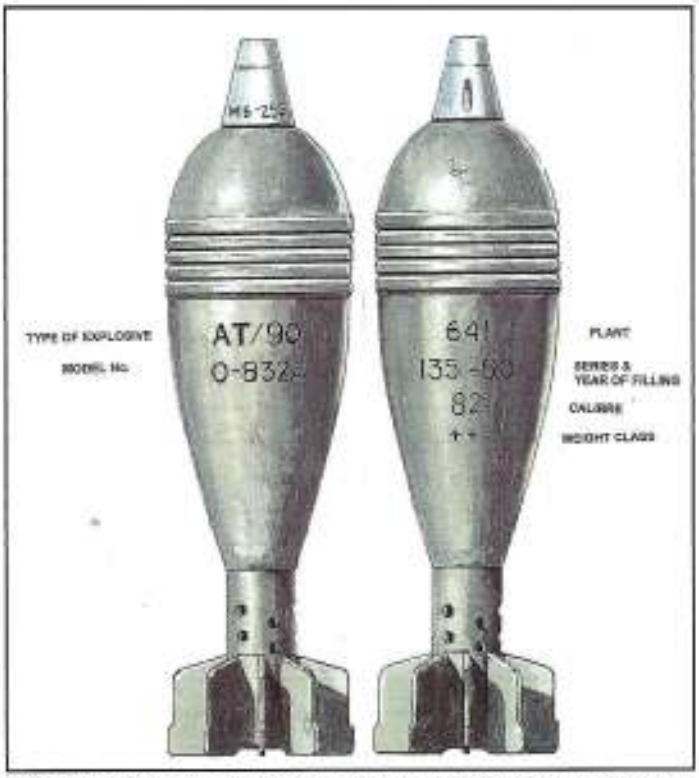
RUSSIAN AMMUNITION MARKINGS

General

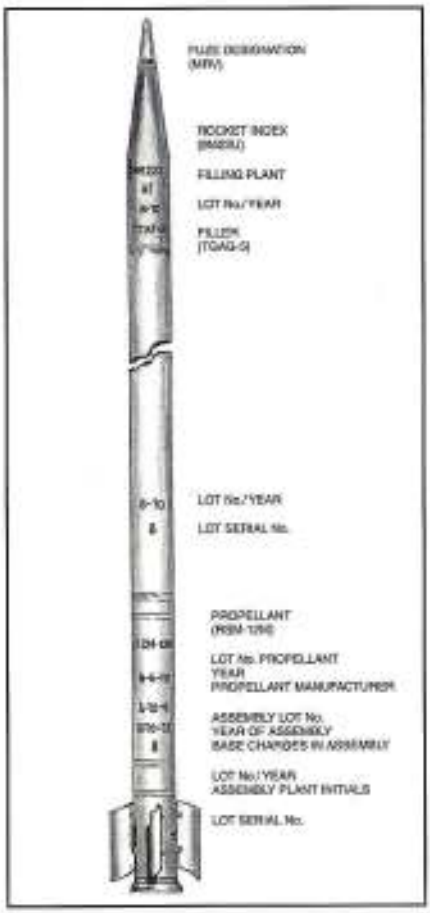
This entry explains and illustrates some of the markings used on ammunition manufactured in Russia, and several other former Warsaw Pact countries. Lettering on older ordnance will be in Cyrillic, but more recent ammunition intended for export may be marked in English. While these markings can convey valuable information if interpreted correctly, they can also be confusing and potentially dangerous if misread. Several of the markings have no significance to the EOD technician, but are explained here for information. Examples of markings on various munitions are given in the accompanying diagrams. Separate entries in this section contain additional information on Russian projectile markings and packaging, munition designations and fillings.



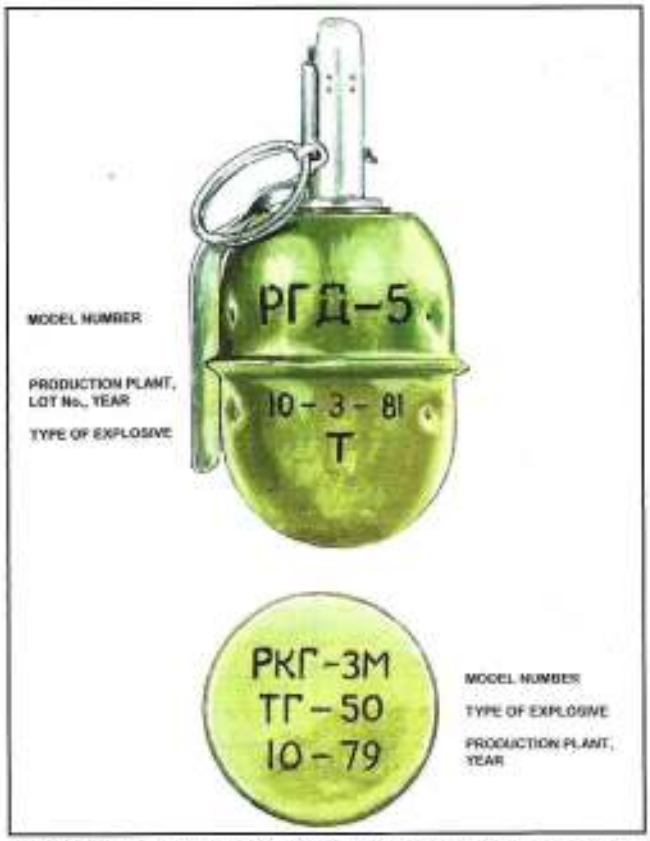
Typical markings on a Russian 122 mm OF-462 HE frag projectile (Lyn Haywood) 0074152



Typical markings on a Russian 82 mm O-832D HE mortar bomb (Lyn Haywood) 0074153



Markings on a Russian 9M22U 122 mm rocket (Lyn Haywood) 0074154



Russian hand grenade markings on a RGD-5 (above) and end of a RKG-3M anti-armour grenade (below) (Lyn Haywood) 0074155

Stamped markings

Marks are generally stamped into metal munition casings during their manufacture at the foundry; these may include the following:

- Factory code
- Lot number
- Type of fill to be used
- Weight zone marks
- Inspection marks
- Smelting number and hardness test.

With the exception of the fill designator (which is an instruction for the filling factory) these marks apply to the casing only.

Stencilled markings

With stencilled markings, particularly where several are placed close together, it is often unclear whether a designation, factory code or lot number is for a component, filling or the entire munition. In some cases it is also difficult to differentiate between lot numbers, factory codes and year of manufacture, since these are often in a single line of markings, but do not always appear in the same order. The following principles normally apply:

Factory code

This may be in the form of a shape, letters, numbers or a combination of these. In many cases, factory number, lot number and year appear in the same marking, but sometimes factory codes appear inside shapes. Bulgaria, for example, prints factory numbers inside two concentric circles. Where more than one factory code is present, this is because subassemblies have been manufactured or filled by different plants. For example it is common for one factory to manufacture a projectile body, another to make the fuze and a third to insert the explosive fill. Where a factory code such as '76' appears in a marking, it is easily confused with the year.

Lot numbers

Lot numbers are usually accompanied by the year of manufacture, with the lot normally preceding the year and separated by a dash. The lot number just gives the batch and does not identify day or month, while the year is denoted by the last two figures. As mentioned in the previous paragraph, certain lot numbers and years are easily confused with factory codes.

Fill designators

The stencilled fill designator denotes the *actual* filling used, while the stamped marking only indicates the *intended* fill. If the two differ, the stamped marking should be ignored and the stencilled marking taken to indicate the real filling. Russian fill designators are listed in separate entries within this section.

Weight zone marks

As with NATO ammunition, Russian ordnance is marked according to its weight category. Average weight ammunition is marked with a Cyrillic H (English N). Underweight ammunition is marked with one or more '–' minus sign dashes and overweight ammunition with one or more '+' plus sign crosses. Stencilled markings relate to the weight zone of the complete projectile, while stamped markings denote the weight variation of the unfilled casing only. The tolerances are given in the *Weight Zone Marks* table.

Marking	Meaning	Marking	Meaning
– – – –	Lighter by 2.33% to 3%	+ + + +	Heavier by 2.33% to 3%
– – –	Lighter by 1.66% to 2.33%	+ + +	Heavier by 1.66% to 2.33%
– –	Lighter by 1% to 1.66%	+ +	Heavier by 1% to 1.66%
–	Lighter by 0.33% to 1%	+	Heavier by 0.33% to 1%

ЛГ	(English LG) More than 3% below standard weight
Н	(English N) Standard weight ammunition, varying by no more than 0.33%
ТЖ	(English TZh) More than 3% above standard weight

Inspection marks

A large number of factory marks are used on former Warsaw Pact ammunition; these have no significance for EOD purposes, but can cause confusion. They are generally smaller than the significant markings, but may take almost any form and be located in virtually any position. Coloured lacquer marks may also be applied, particularly to internal components, at various stages of the manufacturing and inspection process.

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Armour-piercing (AP), with a 'BR' projectile index and 'B' suffix, denoting an 'improved' AP projectile. 'A-IX-2' is the HE fill designator 0074668

A base ejecting carrier projectile containing a flare. The illuminating role is indicated by the white band and 'S' projectile index 0074671

Bursting smoke is designated by the upper black band and 'D' projectile index, while the lower black band denotes a cast steel body. The 'R-4', marking confirms a Phosphorus fill 0074670

High Explosive Anti-Tank (HEAT) projectile bearing the 'BP' projectile index, which was used during World War II. The 'A' suffix may indicate a cast iron casing 0074669

Russian 125 mm tank ammunition. Note the projectile indexes: BM (top) indicating a sabot round and BK (bottom) indicating a HEAT projectile (Colin King) 0074226

Colour codes

Colour codes, as shown in the *Colour Code* table, may be present on projectiles from Russia and other former Warsaw Pact countries, particularly on older ammunition. With some exceptions, the background colour for ammunition manufactured during World War 2 was dark green, while newer projectiles are normally painted grey.

Projectile index suffixes		
Colour code	**Meaning**	**Cyrillic index**
Red body with white stencilling	Propaganda	А ('Agit')
Yellow body	Airburst shrapnel — ball bearing (obsolete)	Ш
Olive green body	Airburst shrapnel — rods (obsolete)	Ш
Black body with white markings	Target practice ammunition	
Blue band	Concrete-piercing	Г
Red band	Incendiary or armour-piercing incendiary tracer	З or БЗР
Black band (towards base)	Cast steel body (separate nose section)	
Black band (towards nose)	Smoke, bursting	Д
White band (towards nose)	Illuminating carrier (delay fuzed)	С

RUSSIAN PROJECTILE MARKINGS

General

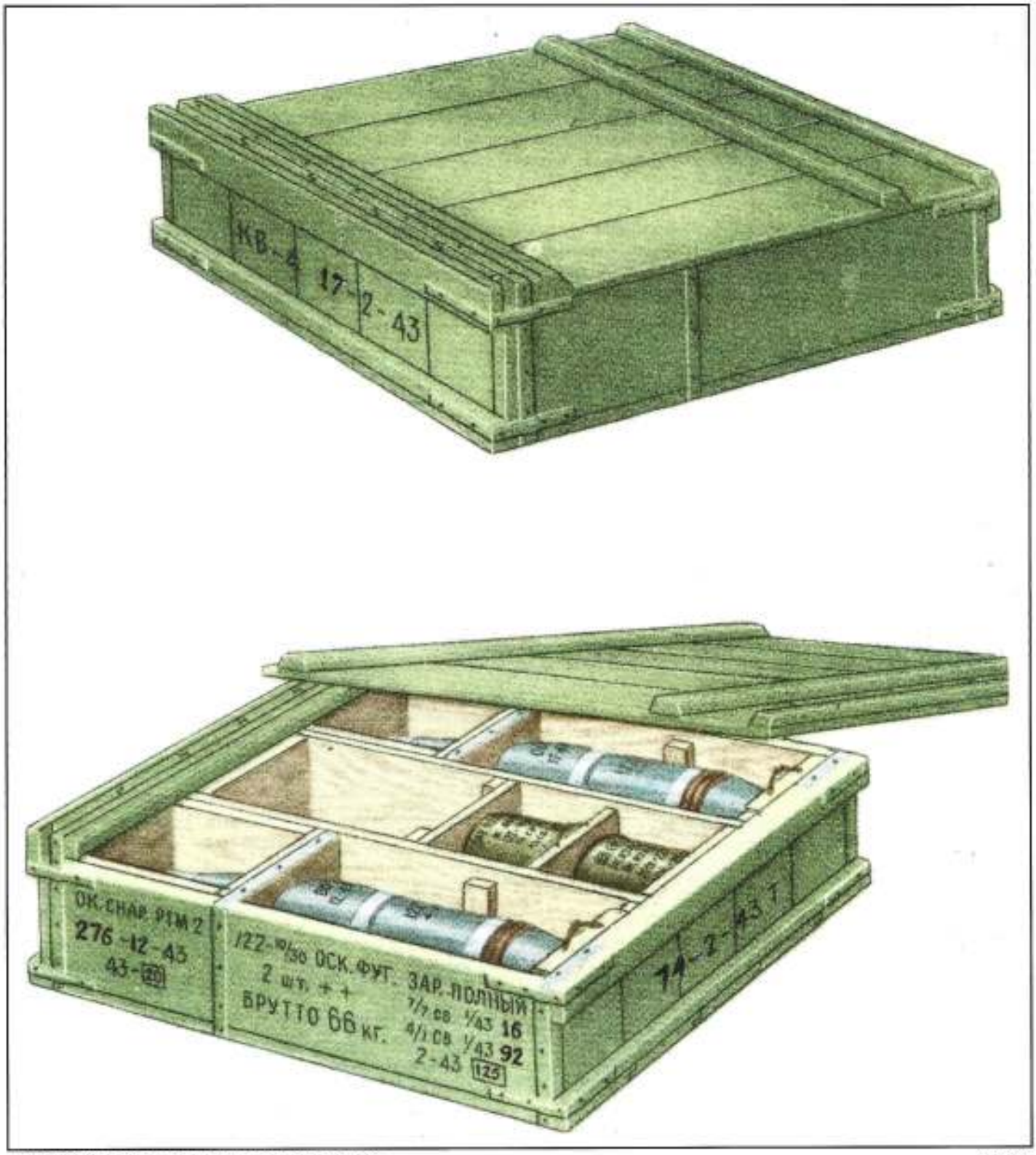
In addition to the standard markings (see *Russian Ammunition Markings*), Russian projectiles are normally stencilled with a projectile index, and may bear a colour code. These provide another aid to identification, although care is needed because codes have changed over the years, and some markings have more than one meaning. The markings used in the following tables have been used by Russia, and several other former Warsaw Pact countries, since 1941.

Projectile index

The projectile index is a code consisting of letters and numbers. The letters, listed in the *Projectile Index Letters and Prefixes* table, denote the type or role of the ammunition. The numbers refer to the gun or system for which the ammunition was first fielded, and have limited value for identification purposes. A suffix, of one or two letters, may be used to give additional detail; these are listed in the *Projectile Index Suffixes* table. Once again, care is needed since the meanings are not always consistent.

Projectile index letters and prefixes		
Cyrillic designation	**English**	**Meaning**
А	A	Propaganda
Б	B	Propellant charge for use in a casing
Б	B	Armour-piercing
БК	BK	HEAT (post-war)
БМ	BM	Sabot rounds (kinetic penetrators)
БП	BP	HEAT (WWII)
БР	BR	Anti-personnel HE fragmentation (WWII)
БР	BR	Armour-piercing tracer
БЗР	BZR	Armour-piercing incendiary tracer
Д	D	Smoke
Ф	F	Blast
Г	G	Concrete-piercing
ИНЕРТ	INERT	Contains no explosive material
Х	Kh	Chemical
ХОЛ	KhOL	Blank
МАКЕТ	MAKET	Training model
О	O	Fragmentation
ОФ	OF	Fragmentation HE
ОСКОЛ	OSKOL	Fragmentation
ОР	OR	Fragmentation tracer
ПРАКТ	PRAKT	Practice (Note: not necessarily inert)
С	S	Illuminating
Ш	Sh	Shrapnel (WWII)
Щ	Shch	Cannister (WWII)
У	U	As a prefix: complete round — unitary (Note: sometimes used to denote 'training')
В	V	As a prefix: complete round — separated
З	Z	Propellant bag charge
З	Z	Incendiary
Ж	Zh	Powder charge (in casing)

Projectile index suffixes		
Cyrillic designation	**English**	**Normal meaning**
А	A	Cast iron
Б	B	Improved armour-piercing projectile
Д	D	Improved armour-piercing projectile
ДУ	DU	Improved fragmentation projectile
К	K	HEAT projectile with copper liner
М	M	Improved fragmentation projectile
Н	N	Improved high-velocity armour-piercing projectile
П	P	Improved high-velocity armour-piercing projectile
ПК	PK	Improved HEAT projectile
С	S	
СП	SP	Improved armour-piercing projectile
У	U	Improved armour-piercing projectile
УМ	UM	Improved HEAT projectile
Ж	Zh	Sintered iron rotating band



Typical markings on a Russian artillary ammunition box

0074672

Markings on a Russian submunition canister
(Colin King)
1341060

RUSSIAN AMMUNITION PACKAGING

The diagram shows a typical wooden Russian artillery ammunition box of the type used during and after World War II. Packaging for other ammunition natures follows similar principles. Some munitions (such as small-arms ammunition) are packed in metal cases of galvanised iron or tin-plated steel; but all are marked according to similar systems. The table explains the markings, (working from top to bottom and left to right).

Location	Marking	Meaning
Top diagram: left-hand side	КВ-4	КВ-4: type of primer
	17-2-43	17: primer manufacturing plant 2: primer lot number 43: year of manufacture
Bottom diagram: Front face, left-hand block	ОК СНАР РГМ 2	Projectiles with nose fuzes РГМ 2
	276-12-43	276: fuze manufacturing plant 12: fuze lot number 43: year of manufacture
	43 — 20	43: year of assembly 20: assembly plant
Front face, centre block	122-10/30	122: calibre 10/30: years of introduction (gun)
	ОСК.ФУГ.	Abbreviated type of round (Fragmentation HE)
	2 ШТ + +	2 ШТ: number of rounds in box + +: weight zone marking (see Russian ammunition markings)
	БРУТТО 66КГ	Gross weight of box complete with rounds (66 kg)
Front face, right-hand block	ЗАР.ПОЛНЫЙ	Name of complete propellant charge/components
	7/7 СВ 1/43 16	7/7 СВ: brand of first propellant composition 1/43: propellant lot number and year of manufacture 16: propellant manufacturing plant number
	4/1 СВ 1/43 92	4/1: brand of second propellant composition СВ: propellant type (Nitrocellulose-based) 1/43: propellant lot number and year of manufacture 92: propellant manufacturing plant number
	2-43-125	2: lot number of propellant assembly 43: year of manufacture for propellant assembly 125: propellant assembly plant number
Right-hand face	74-2-43 Т	74: filling plant number 2: filling lot number 43: year of filling Т: explosive fill designator (TNT)

Notes

The right-hand face of the box may also be stencilled with the projectile index (see *Russian projectile markings*).
The lid of the box may be stencilled with a number in a triangle; this is an 'Explosives' symbol giving the cargo category and hazard group.
Russian HE and propellant and fill designators are listed in separate entries.
The factory codes shown are examples only, and do not relate to actual munition facilities.

RUSSIAN HIGH EXPLOSIVE DESIGNATORS

Introduction

The following HE filling designators and terms are used on ammunition and explosives manufactured in Russia and several other former Warsaw Pact countries. Ammunition designators and other markings are detailed in separate entries. Where known, approximate proportions of mixed fills are given (as percentages) in brackets, though these may vary. See also the entry entitled *Military high explosives* in this section.

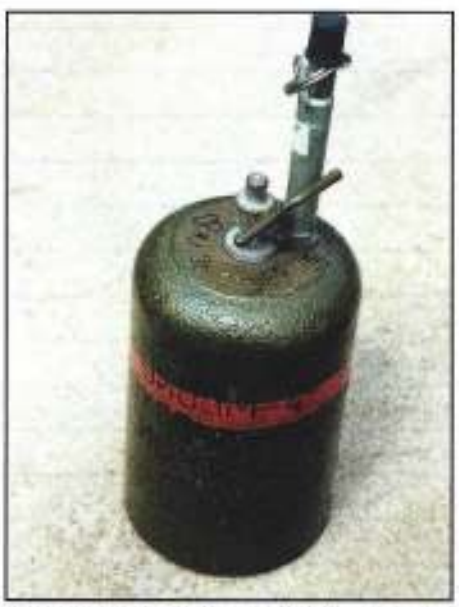
Training munitions

Where a white rectangle or band is stencilled in place of the explosive designator, this normally indicates a training item with an inert filling. The designator may also have a 'U' (У in Cyrillic) prefix to designate it as a training aid.

Where a red rectangle or band is stencilled in place of the explosive designator, this normally indicates a 'training imitation' item with an active pyrotechnic filling. A 'U' or 'UI' (У or УИ in Cyrillic) prefix may also be added to the designator.

Cyrillic designation	English	Meaning
А	A	Ammonium Nitrate
А-40	A-40	Ammonium Nitrate/TNT (40/60)
А-50	A-50	Ammonium Nitrate/TNT (50/50)
А-80	A-80	Ammonium Nitrate/TNT (80/20)
А-90	A-90	Ammonium Nitrate/TNT (90/10)
АЛУМИТ	Alumit	Ammonal (Ammonium Nitrate/Aluminium)
АМАТОЛ	Amatol	Amatol (Ammonium Nitrate/TNT)
АТ-40	AT-40	Ammonium Nitrate/pressed TNT pellet (40/60)
АТ-90	AT-90	Ammonium Nitrate/pressed TNT pellet (90/10)
АТФ-40	ATF-40	Ammonium Nitrate/pressed TNT pellet (40/60)
А-IX-1	A-9-1	RDX/wax (94/6)
А-IX-2	A-9-2	RDX/Aluminium/wax (73/23/4)
А-IX-2Г	A-9-2	RDX/Aluminium/wax
А-IX-20	A-9-20	RDX/Aluminium/wax (78/19/3)
А-IX-П	A-9-P	RDX/Aluminium
АЗИД СВИНЦА	Azid svinsta	Lead azide
ДБ	DB	Dinitrobenzene
ДБТ	DBT	Dinitrobenzene/TNT
ЗВВ-11	EVV-11	'Elastic' explosive: RDX/plasticiser (80/20)
ЗВВ-34	EVV-34	'Elastic' explosive with minimal critical cross-section: PETN/plasticiser (80/20)
Г	G	RDX
ГЕКФОЛ	GEKFOL	Desensitised RDX (normally RDX/wax)
ГЕКСОГЕН	GEKSOGEN	RDX
И	I	IPN (IsoPropyl Nitrate: fuel-air explosive)
К-1	K-1	TNT/Dinitrobenzene (70/30)
К-2	K-2	TNT/Dinitrobenzene (80/20)
ЛД-70	LD-70	Liquid explosive based on EGDN
М	M	Melinit (Picric acid)
МС	MS	RDX/TNT/Aluminium/desensitiser (57/20/17/6)
ОКТОГЕН	OKTOGEN	HMX
ОКФОЛ	OKFOL	HMX/wax (normally 95/5)
ОКФАЛ-20	OKFAL-20	HMX-based explosive
ОКТОЛ	OKTOL	HMX/TNT
ОЛ	OL	HMX/wax (normally 95/5)
П-2	P-2	Black powder
В-4	PVV-4	RDX/plasticiser (79/21)
ПВВ-5А	PVV-5A	RDX/plasticiser (85/15)

Cyrillic designation	English	Meaning
ПВВ-7	PVV-7	RDX (71.5)/Aluminium/wax
ПВВ-12с	PVV-12s	Frost-resistant RDX-based plastic explosive
Т	T	TNT
ТА-77/23	TA 77/23	TNT/Aluminium (77/23)
Т-80	T-80	TNT/RDX (80/20)
ТС	TS	TNT Sulphite
ТД-42	TD-42	TNT/Dinitronapthalene (42/58)
ТД-50	TD-50	TNT/Dinitronapthalene (50/50)
ТДУ	TDU	TNT with aluminium (spotting charge)
ТЭН	TEN	PETN
ТЕТРИЛ	TETRIL	Tetryl
ТГ	TG	TNT/RDX
ТГ-20	TG-20	TNT/RDX (20/80)
ТГ-30	TG-30	TNT/RDX (30/70)
ТГ-40	TG-40	TNT/RDX (40/60)
ТГ-50	TG-50	TNT/RDX (50/50)
ТГА	TGA	TNT/RDX/Aluminium (15/70/15)
ТГА-16	TGA-16	TNT/RDX/Aluminium (60/24/16)
ТГАФ-5	TGAF-5	TNT/RDX/Aluminium (40/40/20)
ТГАФ-5М	TGAF-5M	Desensitised TGAF-5
ТГАГ-5	TGAG-5	TNT/RDX/Aluminium/wax (60/20/15/5)
ТМ	TM	TNT/RDX/Aluminium/wax (35/40/22/3)
ТНРС	TNRS	Lead Styphnate
ТРОТИЛ	Trotil	TNT
ТС	TS	TNT 'Sulphonated' (high grade)
ТТ	TT	'Tetranit' fuel-air explosive compound
Ш	Sh	Ammonium Nitrate/Dinitronapthalene (88/12)
ШТ	ShT	TNT/Ammonium Nitrate/Dinitronapthalene
ВС-6Д	VS-6D	4-component liquid explosive
ВВО-32	VVO-32	TNT/Al/NC (65/20/15)



The red band signifies a 'training imitation' mine with a propellant bounding charge but no HE filling. Note the UI prefix on the OZM-4 designation (Colin King) 0074046

The white rectangle, in place of the explosive fill designator, indicates an inert training item (Colin King) 1154096

This PMN-2 mine bears the explosive designator 'TG-40' (Colin King) 0021197

RUSSIAN PROPELLANT DESIGNATORS

The following table lists some of the terms and designators used for propellants manufactured in Russia and several other former Warsaw Pact countries. See also separate entries *Solid propellants* and *Liquid propellants* in this section.

Cyrillic designation	English	Meaning
4/1, 9/7 etc	4/1, 9/7 etc	Propellant compositions or 'brands'
АК-	AK-	Prefix for Russian liquid oxidants based on Nitric Acid
БАЛИСТИТ	BALISTIT	Ballistite (double-based propellant)
БПК	BPK	Flashless propellant
БПСК	BPSK	Flashless propellant
БСК	BSK	Flashless propellant
ДГ-3	DG-3	Tubular propellant based on Nitrocellulose
ДГ-4	DG-4	Tubular propellant
ФМ	FM	Phlegmatised propellant*
–	FNH	Equivalent to US smokeless, flashless, non-hygroscopic propellant
ГРАФИТ	GRAFIT	Graphited propellant
КАМФ	KAMF	Propellant with Camphor
Х	Kh	Propellant for blank ammunition
КОРДИТ	KORDIT	Cordite (double-based propellant)
Л	L	Strip propellant, used with number to denote thickness in 0.1 mm increments, such as L-3 (0.3 mm thick)
М	M	Low-stability propellant
МК	MK	Stick or tubular propellant based on Nitrocellulose
НБК	NBK	Double-based propellant for mortar ammunition
ПЕР	PER	Old propellant which has been reworked
П-2	P-2	Black powder
ПГ	PG	Flash-reducing propellant
ПЛ	PL	Disc powder, with figures giving thickness and diameter, such as PL 14/10 (0.14 mm thick, 1 mm diameter)
ПОЛНЫЙ	('full')	Term associated with propellant charges meaning 'full' or 'complete'
СА	SA	Nitrocellulose-based propellant for small arms ammunition
СФ	SF	Single-based spherical propellant for small arms ammunition
СМ	SM	Propellant prepared from mixed batches
СТ	ST	Old propellant with added stabiliser
СВ	SV	Nitrocellulose-based propellant
ТР	TR	As a prefix: tubular propellant
ТГ-	TG-	Prefix for Russian liquid fuels
УФ	UF	Propellant with short shelf-life
В/А3	V/A3	Propellant with high Nitrogen content
ВЛ	VL	Single-based propellant for small arms ammunition
ВТ	VT	Single-based propellant for small arms ammunition
ВУФЛ	VUFL	Phlegmatised Nitrocellulose propellant for small arms ammunition*
В/В	V/V	As a suffix: unstable propellant
–	WM	Fine-grained Nitrocellulose-based propellant comparable to British 'WM'

*The term 'phlegmatised' refers to the addition of a desensitiser, normally wax. In addition to reducing sensitivity to impact and friction, wax acts as a lubricant and binder.

RUSSIAN PYROTECHNIC AND CHEMICAL FILL DESIGNATORS

The following fill designators and terms may be marked on chemical, incendiary or pyrotechnic ordnance manufactured in Russia and other former Warsaw Pact countries. As with other Russian designations, careful interpretation is needed as the same letter may have more than one meaning. Also note that the Cyrillic designation 'П-2' (black powder bursting charge) could be mistaken for hydrogen cyanide when written in English as 'P-2'. Explosive and propellant fill designators, ammunition designators and other markings are detailed in separate entries.

Cyrillic designation	English	Type of agent or meaning
ДЫМОВОЙ	Dimovoy	Smoke
Х	Kh	Gas
ХИМИЧеСКаЯ	Khimicheskaya	Chemical
ХАБ	KhAB	Chemical aircraft bomb
КИН-2	KIN-2	Toxic smoke mixture containing DM (Adamsite: vomiting agent)
ОСВЕТИТЕЛЬНЫЕ	OSVETITEL'NYYE	Illuminating
П-2	P-2	Black powder
Р-2	R-2	AC (Hydrogen cyanide: blood agent)
Р-4	R-4	White and yellow Phosphorus
Р-5	R-5	H (Mustard: persistent blister agent)
Р-15	R-15	DM (Adamsite: vomiting agent)
Р-35	R-35	GB (Sarin: nerve agent)
Р-43	R-43	L (Lewisite: blister agent)
Р-55	R-55	GD (Soman: nerve agent)
Р-74	R-74	H (Mustard: persistent blister agent)
РК-7	RK-7	HL (Mustard/Lewisite mixture: persistent blister agent)
РС	RS	L (Lewisite: blister agent)
Р-Ю	R-Yu	CG (Phosgene: choking agent)
З	Z	Incendiary
ЗАБ	ZAB	Incendiary aircraft bomb
ЗАЖИГАТЕЛЬНЫЕ	ZAZHIGATEL'NYYE	Incendiary
ЗБ	ZB	Napalm incendiary bomb

For details of the latest updates to *Jane's Explosive Ordnance Disposal* online and to discover the additional information available exclusively to online subscribers please visit **jeod.janes.com**

Remains of an SUU-65/B Tactical Munitions Dispenser, designated CBU-87/B when filled with BLU-97 submunitions (Colin King) 0534039

An unexploded BLU-97A/B submunition in Kosovo
(Colin King)
0534040

The FZU-39/B proximity sensor from a US cluster bomb used in Kosovo
(Colin King)
0573246

US WEAPON DESIGNATIONS

Current US air-launched weapon nomenclature is based on an identification designator. These letters are followed by a dash, then a serial number to indicate the design; the serial number may also have a letter to indicate first-generation (A) or second generation (B). A forward slash is then followed by a suffix letter to specify the type of installation. Designators are listed in the following table; see also the examples, which illustrate how the designations can be used. Note that a single item may have different designations when combined with other munitions or components.

Designator	Meaning
AB	Explosive item
AD	Weapon adaptor
AG	Air-to-ground
BB	Explosive item
BD	Practice bomb
BL	Bomb, Live (bomb or mine)
BLU	Bomb Live Unit
BR	Bomb rack or shackle
BS	Stabilising or retarding device
CBU	Cluster bomb unit
CC	Actuator cartridge
CD	Clustered munitions
CN	Miscellaneous container
DS	Target detecting device
FM	Munition fuze
FS	Fuze safety and arming device
FZ	Fuze-related item
GA	Aircraft gun
GB	Guided bomb
GF	Gun-related item
GP	Podded gun
GU	Miscellaneous gun
KA	Munition clustering hardware
KM	Kit
LA	Aircraft-installed launcher
LK	Ammunition link
LM	Ground-based launcher
LU	Illuminating unit
M	Army munition
MA	Miscellaneous weapon item
MD	Miscellaneous simulated munition
MH	Munition handling equipment
MJ	Munition countermeasure
MK	Navy bomb
ML	Miscellaneous munition
MS	Munitions countermeasure (old)
MT	Weapon mount
PA	External dispenser
PD	Leaflet dispenser
PG	Ammunition
PW	Internal dispenser
RD	Dummy rocket
RL	Rocket
SA	Weapon sight
SUU	Dispenser suspender and release
SU	Suspension Underwing Unit
TM	Miscellaneous tank
TT	Test items
U	Unit
WD	Warhead
WT	Training warhead

Installation designators

Shown as a suffix after a forward slash

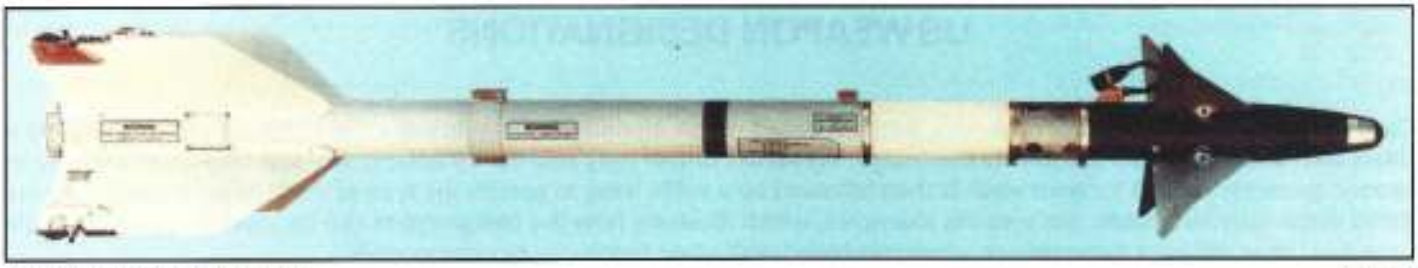
Designator	Meaning
A	Aircraft installed — fixed
B	Aircraft installed — expendable
E	Ground box for munitions

Example 1: SUU-65/B
SU: Suspended underwing
U: Unit
65: Serial number (65th dispenser design)
B: Installation designator (aircraft installed — expendable)

Example 2: BLU-97A/B
BL: Bomb, Live
U: Unit
97: Serial number (97th bomblet design)
A: Model (first version)
B: Installation designator (aircraft installed — expendable)

Example 3: CBU-87A/B (SUU-65/B containing BLU-97A/B)
CB: Identification designator (cluster bomb)
U: Unit
87: Serial number (87th cluster bomb design)
A: Model (first version)
B: Installation designator (aircraft installed — expendable)

Example 4: FZU-39/B cluster bomb fuze sensor
FZ: Fuze-related item
U: Unit
39: Serial number of design
B: Installation designator (aircraft installed — expendable)



AIM-9M 'Sidewinder' (Raytheon) 0552842

YAIM-54A 'Phoenix': the 'Y' prefix that signifies this is a prototype version 0022863

These AGM-65 'Maverick' missiles demonstrate how the design can change substantially within a series. From the front: AGM-65D, -65E, -65B and -65F
0527129

US ROCKET AND MISSILE DESIGNATIONS

Current US rockets and missiles use a combination of letters and numbers to indicate the role and characteristics of the munition. A letter prefix indicates the operational status. This is followed by letters that show where the weapon is launched from, its role and its category. A number indicates the design serial, and may be accompanied by a letter to indicate consecutive generations. See also *US weapon designations*.

Operational status prefix (used only if necessary)

C	Captive (on launcher)
D	Dummy (for training)
J	Special test, temporary
M	Maintenance (for launcher checks)
N	Special test, permanent
X	Experimental
Y	Prototype
Z	Planning

Launch environment

A	Air
B	Multiple
C	Coffin (horizontal enclosure, ground launched)
F	Individual (hand-held)
G	Runway
H	Silo-stored (but not launched from below ground)
L	Silo-launched (stored and launched below ground)
M	Mobile
P	Soft pad
R	Ship
S	Underwater

Mission

D	Decoy
E	Special electronics installation
G	Surface attack
I	Intercept, aerial
Q	Drone
T	Training
U	Underwater attack
W	Weather (meteorological)

Type

L	Launch vehicle
M	Guided missile
N	Probe
R	Rocket

Design number

A figure identifying major design changes within the same mission category. Design numbers begin with '1' and run consecutively within each category.

Series symbol

A letter identifying the version of a particular design, changed with each significant modification. Series symbols begin with 'A' and run consecutively, except for letters 'I' and 'O', which are not used.

Example 1: AIM-9M 'Sidewinder'
(Operational status not used)
A: Launch environment (air)
I: Mission (intercept)
M: Type (guided missile)
9: Design number (9th missile)
M: Series symbol (12th version)

Example 2: YAIM-54A 'Phoenix'
Y: Operational status (Prototype)
A: Launch environment (air)
I: Mission (intercept)
M: Type (guided missile)
54: Design number (54th missile)
A: Series symbol (1st version)

Example 3: AGM-65D 'Maverick'
A: Launch environment (air)
G: Mission (surface attack)
M: Type (guided missile)
65: Design number (65th missile)
D: Series symbol (4th version)

CYRILLIC AND LATIN TRANSLITERATION TABLE

The following *Cyrillic and Latin Transliteration* table is a simplified guide to transliteration between the letters used in the English, Cyrillic and Latin alphabets. Cyrillic markings are used on munitions from many Russian-speaking countries, although English is also used, particularly for export. Cyrillic is also used on Yugoslav ammunition of Serb origin, while Latin tends to be used on Croatian ordnance. Great care is needed during transliteration, as some similar letters have different meanings in other languages. For example, 'C', 'H' and 'P' in Cyrillic mean 'S', 'N' and 'R' in English, but 'C' in Latin equates to 'Ts' in English. In some cases, where few letters are present, it may not be obvious which language has been used.

ENGLISH	CYRILLIC	LATIN
A a	А а	A
B b	Б б	B
Ch ch	Ч ч	Č
D d	Д д	D
E e	Е е/Э э	E
F f	Ф ф	F
G g	Г г	G
I i	И и	I
i (as in ill)	Ы ы	
K k	К к	K
Kh kh	Х х	H
L l	Л л	L
M m	М м	M
N n	Н н	N
O o	О о	O
P p	П п	P
R r	Р р	R
S s	С с	S
Sh sh	Ш ш	Š
Shch shch	Щ щ	
T t	Т т	T
Ts ts	Ц ц	C
U u	У у	U
V v	В в	V
Y y	Й	J
Yu yu	Ю ю	
Ya ya	Я я	
Ye, E (as in yet)	Е е	
Z z	З з	Z
Zh zh	Ж ж	Ž
(')	Ь ь	
(")	Ъ ъ	

Simple markings, in English, on a Yugoslav 60 mm mortar bomb exported to Iraq. Note the reversed lot number, with the series (25) before the year (87) (Ollie Allerhead) 0573247

Markings on a Yugoslav 105 mm projectile (George Zahaczewsky/Colin King) 1374312

Some of the markings on the cartridge case duplicate those on the M67. The Nitrocellulose propellant designation (NC-33) is just visible before the factory code (MBP 6918) (George Zahaczewsky) 0573250

Markings on Yugoslav cannon ammunition (Colin King) 1279635

YUGOSLAV AMMUNITION MARKINGS

General

This entry explains and illustrates some of the markings used on Yugoslav ammunition, which are broadly similar to those used on Russian munitions. Markings may be in Cyrillic, Latin or English; in general, Croatian ammunition was marked in Latin, while Serb ammunition was marked in Cyrillic. Some ordnance manufactured for export was marked in English. Although markings can convey valuable information if interpreted correctly, they can also be confusing and potentially dangerous if misread. It is important to establish which language has been used as some letters appear the same but have different meanings; for example, the letters 'N', 'R' and 'S' in Latin and English are written as 'H', 'P' and 'C' in Cyrillic. The most significant markings are as follows:

Fill designators

Fill designators are normally marked prominently on munitions, usually on a separate line from other markings to avoid confusion, but may not appear on outer packaging. Warheads, cartridges, rockets motors and so forth will bear different designations, which are listed in separate entries. See *Yugoslav high explosive terms and designators* and *Yugoslav propellant and pyrotechnic designators.*

Ammunition designator

Ammunition designations are marked on most items of ordnance and on outer packaging. These may include the category, type and the model of ammunition. In many cases, the model number is prefixed with an 'M', followed by a number that approximates to the year of introduction. This leads to substantial duplication where, for example, M67 may represent a number of different munitions. In some cases, model numbers (M62P1, M62P2 and so forth) may be used to distinguish between types. Where applicable, the calibre, type and model of the firing weapon may also be shown. See *Yugoslav ammunition terms and designators.*

Fuze designator

Fuzes have separate designations, which are normally marked on the fuze body. In some cases, such as on many types of landmine, the fuze designation is the same as that of the parent munition but with the addition of a 'U' prefix (in Cyrillic). For other fuze markings, see *Yugoslav fuze designators.*

Factory code

The factory code is normally two or three letters depicting the initials of the factory name, for example SRB: Slavko Rodic Bugojno. The factory code is often followed by the lot number. Multiple factory codes and lot numbers may be present where a munition is composed of several assemblies (such as projectile, fuze and cartridge case).

Lot numbers

On recent munitions, lot numbers are usually 4-digit numbers. The first 2 digits represent the year of manufacture and the second two digits the series or lot; thus '8702' signifies year of production: 1987, second lot or series. A lot number ending in '00' is likely to be a prototype or pre-production lot.

Some older munitions have the lot number reversed, although this is generally obvious from the figures. For example: 'Ser. 03/70' is the third lot (or series) of 1970.

Other markings

Other markings may include weight zone marks (similar to those found on other former Warsaw Pact and NATO ammunition) and various factory inspection and control marks. Outer packaging will normally include the number of items and the overall weight in kilograms.

Colour codes

The following background colours are normally used:

Grey or olive green with yellow markings	Most ammunition types
Black with yellow markings	Armour-piercing and sub-calibre projectiles
Yellow with black markings	Anti-aircraft projectiles below 40 mm calibre
White with black markings	Practice projectiles
Blue with white markings	Inert training projectiles

Coloured bands are used on some munitions to indicate role, but should not be relied upon in isolation. The following colour codes normally apply:

White	Illuminating
Black	Smoke
Red	Incendiary
Yellow (on smoke munitions)	Toxic or riot agent (CS, for example)
Yellow (on packaging and other munitions)	Practice (may contain live components)
Green	Tracer

See also *Small arms ammunition colour codes.*

YUGOSLAV AMMUNITION TERMS AND DESIGNATORS

The markings shown in the *Yugoslav Ammunition Terms and Designators* table may appear, together with other letters and figures, in designations on Yugoslav ammunition and packaging. Great care should be taken when interpreting markings, since the same letter may have several meanings when used in different contexts. The markings may be in English, Latin or Cyrillic.

See also:

- *Cyrillic and Latin transliteration table*
- *Mine nomenclature — Yugoslavia*
- *Yugoslav ammunition markings*
- *Yugoslav fuze designators*
- *Yugoslav high explosive terms and designators*
- *Yugoslav propellant and pyrotechnic designators.*

Latin or English	Usual meaning
A	Aerial, air-delivered
A	As a suffix: modified version. Blast (eg mine)
B	Bomb, grenade or submunition
Bacač	Launcher
Bomba	Bomb or grenade
Bombica	Submunition
Bruto-Težina	Gross weight
č, čas	Hour (normally delay time)
D, Dimna	Smoke
Eksplozivno	Explosive
F	HE
Fugasna	HE
Granata	Artillery projectile
H, Hemijska	Chemical
Haub, Haubica	Howitzer
K	HEAT
Kazetna	Submunition carrier
Kom	Number or quantity
Kum, Kumulativna	HEAT
M	As a prefix: model (often followed by year of introduction)
M	Abbreviation for *Mina*
Metak	Charge or block (of explosive)
Mina	Mortar bomb, projectile or mine
Municija	Ammunition
O	Bounding (mine), tracer or illuminating
Obelež	Tracer
Odskočna	Bounding (mine)
Osvetljavajuća	Illuminating
P	As a suffix, followed by number: modification number
Panc, Pancirna	Armour-piercing
Protiv-	Anti-
R	Fragmentation, or hand (grenade), or rocket
Raketa	Rocket
Rasprskavajuca	Fragmentation
Ručna	Hand (as in hand grenade)
Školski	Practice
S	Special
T	Time (fuze) or fragmentation
Tempirni	Time
Tr, Tren, Trenutna	Fragmentation
U	Fuze or delay
Upaljača	Fuze
Usporač	Delay
V	As a prefix: practice
Vežbovna	Practice (may not be inert)
Z	Incendiary
Zap, Zapaljiv	Incendiary

Typical markings on ammunition packaging (Colin King) 1279634

An M90 smoke pot. Note the 'CS' fill designation at the top, the yellow band denoting riot agent, and 'DIMNA' meaning 'smoke' (Colin King) 0573248

Examples

KB-1: HEAT submunition, 1st design series
FAB-250: HE aerial bomb, 250 kg nominal weight
RAB-3.5: Fragmentation aerial bomb, 3.5 kg nominal weight

YUGOSLAV FUZE DESIGNATORS

The markings shown in the following *Yugoslav Fuze Designators* table may appear on Yugoslav ammunition fuzes. Great care should be taken when interpreting markings, since the same letter may have several meanings when used in different contexts. The markings may be in English, Latin or Cyrillic.

See also:

- *Cyrillic and Latin transliteration table*
- *Yugoslav ammunition markings*
- *Yugoslav ammunition terms and designators*
- *Yugoslav high explosive terms and designators*
- *Yugoslav propellant and pyrotechnic designators.*

Latin or English	Cyrillic	Usual meaning
A	А	Aerial
BU	ЬУ	Proximity
DDM	ДДМ	Impact, mechanical time
DDP	ДДП	Impact, pyrotechnic time
DI	ДИ	Base, inertia
DT	ДТ	Base, time
SM	СМ	Mechanical self-destruct
SP	СП	Pyrotechnic self-destruct
T	Т	Time
TM	ТМ	Mechanical time
TP	ТП	Pyrotechnic time
TR	ТР	Time fuze (for rockets)
U	У	Fuze or delay
UT	УТ	Fuze, impact
UTE	УТЕ	Fuze, delay, electronic
UTI	УТИ	Fuze, impact, inertia
UT-PE	УТ-ПЕ	Fuze, impact, piezoelectric
UTIU	УТИУ	Fuze, impact, inertia, with delay
UTU	УТУ	Fuze, impact, with delay
V	В	As a prefix: practice

A Yugoslav fuze marked 'БУ' (BU) to indicate a proximity function
(Colin King)
1121275

The marking shows the fuze to be UT (fuze, impact) M57 but could easily be confused with UTM (fuze, mechanical time)
(Colin King)
1341924

YUGOSLAV HIGH EXPLOSIVE TERMS AND DESIGNATORS

The following terms and fill designations, which may be in English, Latin or Cyrillic, are used for HE charges. In addition to military explosives, some commercial explosives have been used in Yugoslav munitions, hence their inclusion in the table.
See also:

- *Cyrillic and Latin transliteration table*
- *Yugoslav ammunition markings*
- *Yugoslav ammunition terms and designators*
- *Yugoslav fuze designators*
- *Yugoslav propellant and pyrotechnic designators.*

Latin or English	Usual meaning
AT 40	Amatol (AN/TNT, 60/40)
AT 50	Amatol (AN/TNT, 50/50)
AT 60	Amatol (AN/TNT, 40/60)
C-10	Yellow/brown detonating cord with 25 g PETN per m
C-12	Blue detonating cord with 28 g PETN per m
C-15	Pink detonating cord with 32 g PETN per m
C-20	Green detonating cord with 38 g PETN per m
C-40	Orange detonating cord with 68 g PETN per m
Geovit-26, 28, 33, 36	A range of commercial blasting explosives
Kontur Vitezit-5	Low velocity commercial explosive
Metanvitezit-5	Commercial powder explosive
MT-4	Cylindrical 3.8 kg TNT demolition charge
MVP-20	Low velocity commercial plastic explosive
NB-1, 2	Very low velocity commercial explosives
PEP	Military plastic explosive
PP-01	Military plastic explosive
T	TNT
Te	Tetryl
T/ZS	High explosive incendiary
Trotilski	TNT
TM-100	Cylindrical 100 g TNT charge; paper or plastic-cased
TM-200	Rectangular 200 g TNT charge; paper or plastic-cased
TM-500	Rectangular 500 g plastic-cased TNT charge
TX 40	TNT/RDX, 40/60
TX 50	TNT/RDX, 50/50
TX 60	TNT/RDX, 60/40
Vitezit-5, 5a, 5b, 5c	A range of low velocity commercial powder explosives
Vitezit-14, 16, 19	A range of commercial semi-plastic explosives
Vitezit-20, 25, 30, 35, 40	A range of commercial plastic explosives
X (in Cyrillic or Latin)	RDX
XF	RDX/wax

YUGOSLAV PROPELLANT AND PYROTECHNIC DESIGNATORS

The following designations, which may be in English, Latin or Cyrillic, are used for propellant charges and pyrotechnic fillings. In some instances, the letters may be followed by numbers to indicate a particular composition, such as 'NC-33'.
See also:

- *Cyrillic and Latin transliteration table*
- *Yugoslav ammunition markings*
- *Yugoslav ammunition terms and designators*
- *Yugoslav high explosive terms and designators.*

Latin or English	Usual meaning
BF	White Phosphorus
CB	Black powder
CS	CS riot agent
NC	Nitrocellulose
NCD	Nitrocellulose with additives
NGB	Nitroglycerine/Ballastite
NGH	Nitroglycerine, cannon, cold
NGT	Nitroglycerine, cannon, hot
NGR	Nitroglycerine, rocket
NGV	Nitroguanidine, triple-base
OS	Illuminating composition
TS	Thermite composition

EXPLOSIVES

COMMERCIAL HIGH EXPLOSIVES

Commercial explosives are often used in terrorist attacks, and sometimes in military munitions when stocks of military-grade explosives run low. There are hundreds of commercial explosive types, some available in a number of different compositions. The following table lists some of the more common types.

See also:

- Background information on explosives
- Separate entry: *Military high explosives*
- Separate entry: *Home-made explosives*
- Separate entry: *Solid propellants*
- Separate entry: *Liquid propellants*
- Entries on Russian explosive, propellant and pyrotechnic designators are listed in the *Markings* subsection.

Name or designation	Country	Composition	Remarks
A	Russia	Ammonium nitrate (AN)	
A-3	Former Yugoslavia	Plastic explosive	
Afocite	Italy	AN-based	Blasting explosive
Aguatol	Russia	AN/TNT based	May be dry or wet
Akhgar	Iran	Gelatinous	Low velocity
Akvanit	Russia	Various	A range of commercial explosives
Al or -al (as a suffix)	Various	Aluminium (Al)	Often used to signify the addition of aluminium
Aldinex	Ireland	Powder	Packed in plastic tubes
Aldorfit	Switzerland	AN/TNT based	May also contain Aluminium
Alkalite	Belgium	AN-based	
Alpinit	Austria	NG-based	Gelatine
Alsilite	Belgium	AN/TNT based	
Alumit	Russia	AN/Al	Also used by the military
Ammonie/Ammonit/Ammonite	Various	Various AN-based compositions	Includes Austrian, Bulgarian, German, Italian and Russian explosives
Ammon-gelignite/gelatine	UK	AN/NG based	
Ammon-Gelit	German	NG-based	A range of dynamite explosives
Ammoniiti	Finland	AN/Fuel oil	Red prilled explosive
Ammosol	Russia	AN-based	
Ammospex	UK	AN/Fuel oil	Packed in tubes
Amon/Amonalita/ Amonita/Amolite	Various	AN-based	Commercial explosives
AN		Ammonium Nitrate	Common abbreviation
ANC	German	AN/Fuel oil	German for ANFO
Andex 1, 2	German	AN/Fuel oil	Trade name for ANFO
ANFO	Various	AN/Fuel oil	Common abbreviation
Anobel	UK		Blasting explosive
Anolit	Norway	AN/Fuel oil	Yellow colour
Aquadex/Aquagel	Belgium		For underwater use
Aquaspex	UK	NG-based	Semi-gelatinous
AS-4, 8	Russia	AN/Al/oil	
Astralit/Astralita/Astralite	Various	Various	Includes German and Spanish explosives
Astrolite, Astro-Pak	Unknown	AN/Hydrazine	Binary solid/liquid
Avalit	Greece	NG-based	Gelatine dynamite
BAM	France	NG-based	Gelatine dynamite
Belex/Belgex	UK/Brazil	NG-based	Semi-gelatinous
Bellite	Sweden	AN-based	Also used by the military
Bicarbite/Bikarbit	Belgium/Germany	NG-based	Contains a high proportion of Sodium Bicarbonate
Black powder	Various	Potassium Nitrate/ Charcoal/Sulphur	Often referred to as 'gunpowder', also used in munitions and fireworks
Blasting Gelatine	Various	NG/NC	Stiff gel
Carbonex	Greece	Various	
Carbonit/Carbonita	Various	NG-based	Contain Sodium or Potassium Nitrate
Centralite TA	Belgium	AN-based	
Centrex	Canada	NG/DNT-based	Packed in plastic tubes
Cheddit/Cheddita/Cheddite	Various	Various	Explosives based on Chlorates or Perchlorates
Damotin	Indonesia	AN-based	AN gelatine dynamite
Danfo	Indonesia	AN-based	Pink colour
Danubit	Czech Republic	Various	Gelatinous Ammonia dynamites

Name or designation	Country	Composition	Remarks
Delse A, B and F	Argentina	Chlorate-based	
Demex	UK	RDX-based	
Denespex	UK	NG-based	
Detonit	Russia	AN-based	A range of commercial explosives
Dinamit/Dinamita/Dinamite	Italy/Russia/Spain	NG-based	National terms for Dynamite
Dinamon	Italy	AN-based	
DNT	Various	DiNitroToluene	Used in some explosive mixtures and often present as an impurity in TNT
Donarit	Austria/Germany	NG-based	A range of mining explosives
Driftex	UK	NG-based	Semi-gelatinous
Dynafrax	UK	NG-based	Semi-gelatinous
Dynagel	Germany	Slurry explosive	Supplied in large plastic tubes
Dynagex	UK	NG-based	Semi-gelatinous
Dynalite R	France	NG-based	Semi-gelatinous. Blue colour
Dynamex AM, B	Sweden	NG-based	Gelatinous explosives
Dynamex M	Sweden	AN-based	Also contains EGDN and DNT
Dynamite	Various	NG-based	May contain various explosives and additives
EL-102, 103, 104	China		A range of emulsion explosives
Emulite	Various		A range of emulsion explosives produced in Malaysia, Pakistan and Sweden
Fixor	Canada	Two-component liquid explosive	Based on either Nitroethane or Nitromethane
Foamex	UK	AN-based	Low-power aqueous foam explosive
Fordit	Germany	AN/NG-based	A range of gelatine dynamites
Fortex	UK	NG-based	Gelatine
Frangex	Ireland	NG-based	Gelatine
Fullpulver 1-110	Germany	Various	An extensive range of explosives, mostly for military use
Gelatin/Gelatina/Gelatine/Gelex	Various	NG-based	Mainly as a prefix for blasting explosives
Gelignite	Various	NG-based	Strength is varied by the proportion of NG
Geovit	Former Yugoslavia		A range of commercial slurry explosives
Gom/Goma/Gomma/Gomme	Various	NG-based	Used by Greece, Italy, Spain and Portugal
Granitol/Granulti	Russia		A range of granulated explosives
Heraclit	Greek	NG-based	A range of gelatinous explosives
Hi-Drive	Canada	NG/NC/AN/fuel	
Igdanit	Russia	AN/Fuel oil	
Infernit	Czech Republic	NG-based	Plastic dynamite packed in cartridges
Iregel/Iregex/Iremite	Belgium/Brazil/UK	Various	Slurry explosives
Kamex	Slovenia	Various	A range of slurry explosives
Kamniktit	Germany, Slovenia	Powder explosive	Similar characteristics to TNT
Kiri No 1, 2 and 3	Japan	AN-based	Gelatinous dynamites
Knauerit	Austria	PETN-based	Plastic explosive
Lambrex	Austria	Slurry	
Lambrit	Austria	AN/Fuel oil	Trade name for ANFO
Latex 8, 28, 33	Iraq	Various	A range of dynamite explosives
Lawinit	Austria	Slurry	For avalanche loosening
Lexfoam	US	Nitromethane-based foam explosive	Used primarily for EOD work. Now known as NMX-foam
Minespex	UK	NG-based	Packed in waxed paper tubes
Multicord 40 and 100	Germany	PETN	Red detonating cord
Nabit A	Sweden	NG-based	Ammonium dynamite
Nagolite	Portugal	AN/Fuel oil	
NALIT 110-117	Former Yugoslavia	Various	A range of slurry explosives
NG		Nitroglycerine	Common abbreviation
Nidin	Hungary	NG-based	A range of dynamite explosives
Nilite	Canada	AN/Fuel oil	Various compositions
Nitrol 1 and 2	Slovenia	AN/Fuel oil	
Nitur	Hungary	AN/NG/TNT/resin	Packed in paper tubes
NMX-foam	US	Nitromethane-based foam explosive	Formerly known as Lexfoam
Nobelit/Nobelite	Various	NG-based	Used by France, Germany, Switzerland and UK
Nonel	Norway and Sweden	HMX/Al	An explosive tube system used for non-electric charge initiation

Name or designation	Country	Composition	Remarks
Obrisit	Czech Republic	NG-based	Gelatinous dynamite with Polystyrene
OE 6339, 6391 and 6410	UK	NG-based	Packed in waxed paper tubes
Paxit	Hungary	AN/TNT-based	A range of commercial explosives
Pelonit D	Austria	NG/Al	Powder explosive
Penobel 1 and 2	UK	NG-based	Normally packed in waxed paper tubes
Permex	Austria	NG-based	
Permitted explosives	Various	Various	Mining explosives designed to avoid the initiation of flammable gases and coal dust
Permon	Czech Republic	Various AN-based	Permon DAP is a range of ANFO explosives
Perunit 20-48	Czech Republic	Various NG-based	Plastic dynamite explosives
Perunit HG	Czech Republic	PETN-based	Plastic explosive
Petrogel/Petrovil/Petrozul	Argentina	NG-based	Gelignites of various strengths
Pierrit	Switzerland	Chlorate-based	
Plaster Gelatine	UK	NG-based	Gelatinous blasting explosive
Plastic explosive or plastique	Various	Various	Generic terms for mouldable high explosives
Polar Ajax	UK	NG-based	Gelatinous blasting explosive
Polvere/Poudre	Italy/France		Term meaning 'powder'
Powergel	Indonesia	Various	A range of blasting explosives
Prillit	Sweden	AN/Fuel oil	
Primafoam	UK/US		Foam Explosive
Primasheet 1000	UK	PETN-based	Range of sheet explosives for specialist applications
Primasheet 2000	UK	RDX-based	Range of sheet explosives for specialist applications
Prykalit 1 and 2	Greece	AN/NG/DNT	Packed in paper tubes
Pyrkaloplast	Greece	AN/NG-based	A range of blasting explosives
Quarrex	UK	NG-based	A range of blasting explosives
Reolit A, B, C and D	Sweden	AN/Fuel oil	
S-2	Russia	AN-based	Granular explosive
S-3	Pakistan	NG-based	Gelatinous explosive for seismic applications
Sabulita/Sabulite	Belgium/Italy/Spain	AN/TNT-based	Various compositions
SAK-PAK	Canada	AN-based	Water gels
Sakuma No 1 and 2	Japan	NG-based	Blasting gelatine
Saldin and Saldin-E	Hungary	NG/NC-based	Gelatines
Seamespex/Seamex	UK	NG-based	Powders
Seismocord	Germany	PETN	A range of detonating cords
Seismo-Gelit	Germany	NG-based	Gelatinous explosive supplied in hard or soft cartridges
Seismopak	Germany	n/k	Flat charges used for surface detonation
Seismoplast 1	Germany	n/k	Plastic explosive for use under high pressure or low temperature
SEMTEX 1A, 1AP, 2P, 2PN, 10, S25, S30, S35	Czech Republic	PETN-based explosives	A range of commercial explosives; SEMTEX 1A, 1AP, 2P, 2PN and 10 are plasticised; S25, S30 and S35 are powders
SEMTEX H	Czech Republic	RDX/PETN (proportions vary)	Plastic explosive; formerly used in numerous terrorist attacks
Shin-kiri/Shinkyoryoko/ Shin-toku-shoan/Shiraume	Japan	AN-based	
SINOXID	Austria	Various	Non-corrosive primer compositions
SINTOX	Austria	Various	Non-toxic and non-corrosive primer compositions
Slurrit	Norway	Various	A range of insensitive slurry explosives
Sofranex	France	NG-based	Gelatine
Sofranex A	France	AN/NG-based	Plastic
Subaq and Subgel	UK	NG-based	Packed in orange plastic tubes
Sunvex	Japan	AN-based	A range of water gels
Togel	UK	NG-based	Gelatine
Tolamite	France	AN-based	Plasticised
Toval	Canada	NG/NC-based	
Tovex	Canada	AN-based	A wide range of water gels and slurries
Tutagex	Italy	Various	A range of water gel explosives

Name or designation	Country	Composition	Remarks
Uglenit	Russia	Various	A range of commercial explosives
Unigel/Unigex	UK	NG-based	Gelatine explosives
Vibral/Vibrazul	Argentina	AN-based	Powders
Vitezit — 5 series	Former Yugoslavia	Various	A range of commercial powder explosives
Vitezit — 14, -16, -19	Former Yugoslavia	Various	A range of commercial semi-plastic explosives
Vitezit — 20, -25, -30, -35,-40	Former Yugoslavia	Various	A range of commercial plastic explosives
Vulcan 3a, 3n and 3s	Italy	NG or TNT based	Powders
Wabo	Pakistan	Various	A range of commercial explosives
Wetter	Germany	Various	Prefix for a range of commercial explosives
Wincoal 'A'	UK	NG-based	Powder packed in waxed paper tubes

'HOME-MADE' EXPLOSIVES

'Home-made' explosives tend to be used in Improvised Explosive Devices (IEDs) when military or commercial explosive is unavailable, but they are also found in larger devices where the use of manufactured explosive is considered wasteful. An explosive or incendiary mixture can be made from virtually any combination of powerful oxidising agent and fuel, but certain types are widely used because of their availability or performance. The following table lists some of the better-known explosives; some constituents are also listed, since they may indicate bomb-making activities if discovered during a search operation.

See also:

- Background information on explosives
- Separate entry: *Military high explosives*
- Separate entry: *Commercial explosives*
- Separate entry: *Solid propellants*
- Separate entry: *Liquid propellants*
- Entries on Russian explosive, propellant and pyrotechnic designators, listed in the *Markings* subsection.

Name	Composition	Remarks
Acetone		Used as a solvent, and as a constituent of home-made explosive
Al or -al (as a suffix)	Aluminium (Al)	As a silver powder or dust. Used in thermite, as an energetic fuel or additive in several explosive mixtures
AN	Ammonium Nitrate	Oxidising agent sold commercially as a fertiliser. The basis for many commercial and home-made high explosives
Ammonium Perchlorate		Oxidising agent, often mixed with fuels such as aluminium
ANAL	AN/Al (proportions vary)	High explosive; detonator-sensitive
ANFO	AN/Fuel Oil	Low velocity high explosive, often improvised or home-made, but also used commercially and by the military. Normally requires an HE booster charge
'Annie'	AN/Nitrobenzene (NB)	High explosive; detonator-sensitive
ANS	AN/Sugar	High explosive; can be made detonator-sensitive. (Also the term for an Italian military explosive)
Barium Peroxide	Various	Oxidising agent used mainly in incendiary mixtures. Not readily available commercially
Charcoal, coal, carbon	Various	Used as a fuel in explosive and incendiary mixtures when finely powdered. A constituent of gunpowder
Citric acid		A white powder sold for cooking. Used in the preparation of certain home-made explosives
Co-op	Sodium Chlorate/NB	High explosive; detonator-sensitive
Glycerine	Various	Clear syrupy liquid, sold commercially as a sweetener. Used as a fuel in some incendiary mixtures. Although used in the production of Nitroglycerine, this is rarely 'home-made'
Gun cotton	Nitrocellulose	Easily made HE, but rarely used by terrorists
Gunpowder	Various	Often used as a generic term for explosive mixtures, including Black Powder. Sometimes extracted from fireworks.
Hydrogen Peroxide		A powerful oxidising agent used in some explosives. Normally sold diluted in water
Iron Oxide		A component of common thermite mixtures
Magnesium	Various	As a grey powder or dust. A highly energetic fuel used in explosive and incendiary mixtures
Matches	Alone	Match heads, particularly friction-sensitive types, are sometimes used in crude IEDs
Mercury		Used for the production of Mercury Fulminate primary explosive
Methyl Nitrate	Alone	Volatile liquid with properties similar to Nitroglycerine

Name	Composition	Remarks
Napalm	Normally based on petrol and thickener	Generic term for a range of fuel-based gels
Nitric acid		Normally clear or slightly yellow liquid used in the nitration process for the production of many high explosives
Nitrogen Triiodide	Alone	Highly sensitive Iodine compound initiated by touch
Phosphorus	Often used with liquid fuels	Sometimes used for its spontaneous ignition on exposure to air, as in the 'Molotov Cocktail' incendiary
Plastic explosive or plastique	Various	A generic term for mouldable high explosives
Potassium Chlorate	Various	A powerful oxidising agent used in many explosives. Not readily available commercially
Potassium Nitrate	Various	Oxidising agent; the primary constituent of Gunpowder
Potassium Permanganate	Various	Powerful oxidising agent, sold commercially as an antiseptic. Deep purple crystals
Sodium Chlorate	Often mixed with sugar	Oxidising agent sold commercially as a weedkiller. Used in varying proportions to make incendiary, propellant or HE mixtures
Sodium Nitrate	Mixed with fuels	Oxidising agent
Sodium Peroxide	Various	Oxidising agent used mainly in incendiary mixtures, which can sometimes be initiated by moisture
Sugar	Often mixed with Sodium Chlorate	Often used as a fuel in home-made explosives. Almost any type of sugar can be used, though some types suit specific applications better than others
Sulphur	Various	Normally seen as a pale yellow powder, sold commercially for medicinal use. Used in several explosive and incendiary mixtures, including Gunpowder
Sulphuric acid		Normally clear or light brown liquid used in the nitration process for the production of many high explosives. Also used to initiate some mixtures by spontaneous combustion on contact
TATP	Triacetone Triperoxide	Sensitive and unstable high explosive used in many recent terrorist attacks
Thermite	Various	High-temperature incendiary mixtures made using a reactive metal powder and a metal oxide (e.g. Aluminium and Iron Oxide)
Urea/Urea Nitrate		Urea fertiliser is nitrated to form Urea Nitrate, which is a high explosive with a short shelf life
Vaseline	Often mixed with Potassium Chlorate	Petroleum jelly, used as a plasticiser and fuel in some improvised explosive compositions
Zinc	With oxidising agent or Sulphur	As a grey powder or dust. An energetic fuel used in explosive and incendiary mixtures

MILITARY HIGH EXPLOSIVES

The following table lists the names, compositions and abbreviations for the more common military explosives used by various nations. For explosive mixtures, approximate proportions (where known) are shown as percentages in brackets; these proportions may vary between different compositions.

See also:

- Background information on explosives
- Separate entry: *Commercial high explosives*
- Separate entry: *Home-made explosives*
- Separate entry: *Solid propellants*
- Separate entry: *Liquid propellants*
- Entries on Russian explosive, propellant and pyrotechnic designators, listed in the *Markings* subsection.

Name or designation	Country	Composition	Remarks
808	UK	NG-based explosive	Obsolete plastic explosive
A	Russia	Ammonium nitrate (AN)	
A-3	Former Yugoslavia	Plastic explosive	
A-40, 50, 80, 90	Russia	AN/TNT	Figure indicates percentage of AN
A-IX-1	Russia	RDX/wax explosive	Approximately 94/6
A-IX-2, P, 20	Russia	RDX/aluminium explosives	Various proportions
A-IX-10	Russia	HMX	Pressed
Al or -al (as a suffix)	Various	Aluminium (Al)	Often used to signify the addition of aluminium
Alex 20	UK	RDX/TNT/Al	Composition B with 20% Al
Alumatol	Various	AN/TNT/Al (77/20/3)	
Amatex	UK	TNT/AN/RDX	Pourable mixture
Amatol	Various	TNT/AN	Proportions vary
Amatol 39a, 40, 41	Germany (WWII)	AN-based explosives	Mixed with several other explosives, including RDX
Ammonal	Various	AN/Al	May also contain charcoal or TNT; sometimes used as a home-made explosive
Ammonit/ammonita	Various	AN-based explosives	
Ammonite	Various	AN/TNT	Normally 80/20
AN		Ammonium Nitrate	
ANFO		AN/Fuel Oil	Also used as a commercial and home-made explosive
AP		Ammonium Perchlorate	
AS-4, 8	Russia	AN/Al/oil	
ASA		Lead Azide/Lead Styphnate/ Aluminium	Flash-receptive composition
AT	Russia	AN/TNT	Abbreviation for Amatol
'Aunt Jemima'	UK, US	HMX/flour	WWII sabotage explosive disguised as flour for concealment
B2166/B2170	France	RDX-based	Composite explosive
B3003/B3008	France	HMX-based	Composite explosive
B4	Italy	Trinitroanisol/Al	Normally 65/35
Baratol	UK (WWII)	TNT/Barium Nitrate	Proportions vary
Baronal	UK (WWII)	Barium Nitrate/TNT/Al (50/35/15)	
Black powder	Various	Potassium Nitrate/ Charcoal/Sulphur	Often referred to as 'gunpowder', also used in fireworks
Blasting gelatine	Various	NG/NC (93/7)	Powerful commercial explosive; proportions vary by 1–2 %
BTM	Unknown	Tetryl/TNT/Al (55/25/20)	Castable explosive
C4	US/various	RDX/plasticiser	See Composition C4
C-6	Germany	Methylamine Nitrate/ Sodium Nitrate/RDX	TNT substitute
C-40	S Korea	RDX-based plastic explosive	Korean version of US C4
CBS	Unknown	RDX/Butyl stearate/stabiliser	Plastic explosive, approximately 84% RDX
CE	UK	Tetryl	Stands for composition exploding
CL20			Alternative name for HNIS/HNIW
Composition A	UK (WWII)	RDX/wax (91/9)	Proportions may vary slightly
Composition A3	US	RDX/wax (91/9)	Projectile filler
Composition A4	US	RDX/wax (97/3)	Used for boosters
Composition A5	US	RDX/wax (Approx 98/2)	Used for shaped charges and grenades
Composition A6	US	RDX/wax (91/9)	Projectile filler
Composition B	Various	RDX/TNT (normally 50/50 or 60/40)	Proportions vary
Composition B	US	RDX/TNT/wax (59.5/39.5/1)	

Name or designation	Country	Composition	Remarks
Composition B2	US	RDX/TNT (60/40)	
Composition B3	US	RDX/TNT (59.5/40.5)	
Composition C	UK (WWII)	RDX/plasticiser/binder	
Composition C	US	RDX/inert plasticiser (88.3/11.7)	Plasticiser based on oil with 0.6% Lecithin
Composition C2	US	RDX/explosive plasticiser (88.3/11.7)	Plasticiser based on Nitrotoluenes
Composition C3	US	RDX/explosive plasticiser (77/23)	Plasticiser based on Nitrotoluenes
Composition C4	US	RDX/plasticiser (Approx 90/10)	Sometimes known as Harrisite; plasticiser based on Polyisobutylene
Composition CH6	US/Norway	RDX/plasticisers (Approx 97.5/2.5)	Used for boosters and leads
Cyclonite	Various	RDX	Alternative name for RDX
Cyclotol	US	RDX/TNT	Like Composition B, but 69–75% RDX
Detasheet	US	PETN-based	Flexible sheet explosive
Dynamite	Various	Nitroglycerine (NG) - based explosives	Often used as a generic term
EDC-1	UK	HMX/TNT (70/25) plus RDX and wax	
EDC-37	UK	HMX/NC plus 9% polyurethane	
EGDN	Various	Ethylene Glycol Dinitrate	Present as an impurity in NG-based explosives
EL-506	US	PETN-based	Flexible sheet explosive
EVV-11	Russia	RDX/plasticiser (80/20)	Described as elastic explosive
EVV-34	Russia	PETN/plasticiser (80/20)	Elastic explosive with minimal critical cross-section
Exogen/exogeno	Italy/Spain	RDX	
Fp 02	Germany	TNT	In various forms
Füllpulver Nr 1-110	Germany	Various	A range of explosives; may be abbreviated to Fp
Gekfol	Russia	RDX/wax	
Geksogen	Russia	RDX	May be spelt gheksoghen
Gelignite	Various	NG-based explosives	Often used as a generic term
Gun cotton	Various	Nitrocellulose	See NC
Gunpowder	Various		See black powder
H6	US	RDX/Al/wax (45/30/21)	High-blast explosive
H-762, 764	Norway	HMX-based explosives	
H872	China	HMX-based explosive	
HBX-1	US	RDX/TNT/Al/wax (40/38/17/5)	High-blast explosive
HBX-3	US	RDX/TNT/Al/wax (31/29/35/5)	High-blast explosive
Hetro	Finland	RDX/TNT (50/50)	Finnish term for Composition B
Hexal	Various	RDX/Al/wax	High-blast explosive
Hexogen/Hexogene	Various	RDX	Alternative name for RDX
Hexolite	France	RDX/TNT/wax (59.5/39.5/1)	French term for Composition B
Hexotol	Sweden/Norway	RDX/TNT (60/40)	Swedish term for Composition B
Hexotonal	Sweden/Norway	RDX/TNT/Al (60/40)	Swedish term for Torpex
HMX	Various	Cyclotetramethylene-tetranitramine	High-Melting Explosive; an analogue of RDX; also known as octogen
HNIS or HNIW	US	Hexanitrohexaazaisowurtzitane	High-performance secondary explosive
HNS		Hexanitrostilbene	Secondary explosive
HT	France	RDX/TNT (60/40)	French designation for Composition B
HTA-3	US	HMX/TNT/Al (49/29/22)	High-blast explosive
Idrolita	Italy	AN/RDX/water/paraffin (70/20/7/3)	
KMA Ladung	Germany	TNT-based (40%)	Aluminised castable bursting charge
LDNR		Lead dinitroresorcinate	Primary explosive used in detonators
Lead azide			Primary explosive used in detonators
Lead styphnate			Primary explosive used in detonators
LMNR		Lead mononitroresorcinate	Primary explosive used in detonators
LX-	US	HMX/additive	A range of powerful liquid and plastic explosives, mostly based on HMX
LX-01	US	Not known	Liquid explosive
LX-02, 03, 13	US	HMX/additive	Soft plastic
LX-04-1, 07-2, 10-0, 10-1, 11-0	US	HMX/Viton A (synthetic rubber)	Plastic
LX-09-0, 09-1	US	HMX/DNPA	Plastic
LX-14-0	US	HMX/estane 5702-F1	95.5/4.5; white solid with violet spots
LX-15	US	HNIS/Kel-F (binder)	95/5

Name or designation	Country	Composition	Remarks
LX-16	US	PETN/FCP461	
LX-17-0	US	TATB/Kel-F (binder)	92.5/7.5
Lyddite	UK	Picric acid	Old British name for picric acid
M	Russia	Picric acid	Also designates Russian version of ANFO
MAT	Italy/Spain	Picric acid/TNT (60/40)	Used for medium-calibre projectiles
MBT	Various	Picric acid/ dinitrophenol (60/40)	
MC	Russia	TNT/RDX/Al	
Melinite	Germany	Picric acid	Old German name for picric acid
Mercury Fulminate			Primary explosive, no longer in general use
Minex	US	RDX/TNT/AN/Al	Cast munition filling
Minol	US	TNT/AN/Al (40/40/20)	Pourable munition filling
MOX	US	Various	A range of compositions; stands for Metal Oxidiser Explosives
MOX-1	US	Tetryl-based	With metal powders and oxidiser
MOX-2B, 3B, 4B	US	RDX/TNT-based	With metal powders and oxidisers
MOX-6B	US	RDX/Al-based	Also contains Copper Oxide
Nitramite	Italy	AN/Al/bitumen (73/22/6)	Ammonal-type bursting charge
Nitrocellulose (NC)			Also known as gun cotton; often used in mixtures, particularly in propellants
Nitroglycerine (NG)			Glycerol trinitrate, or 1,2,3-propanetriol trinitrate
Nitroguanidine			Normally used in mixtures with other explosives; usually known as picrite
Nitromethane (NM)			Liquid explosive compound, normally used with a sensitiser
Nitropenta	Various	PETN	Term used by Argentina, Brazil, Germany and Spain
No 1, 4, 5	China	RDX-based plastic explosives	C4 equivalents; proportions vary
Nonel	Norway and Sweden	HMX/Al	Explosive-lined tube for non-electric charge initiation
NP-2, 5, 10, 15	Czech Republic	PETN-based explosives	Used in plastic explosives and boosters
NSP-72	Sweden	RDX-based plastic explosive	
NT	France	AN/TNT (70/30)	French designation for Amatol
NTMX	France	AN/Trinitroxylene (78/22)	Bursting explosive used in projectiles
NX	France	AN/Trinitroxylene (70/30)	Bursting explosive used in projectiles
Octogen/Octogene	Various	HMX	Alternative name for HMX
Octol	US	HMX/TNT	Either 70 or 75% HMX
Okfol	Russia	HMX/wax (95/5)	
Oktogen/oktoghen	Russia	HMX	
Oktol	Russia	HMX/TNT	
P-25	Former Yugoslavia	Plastic explosive	
PBHV-85/15	US	HMX/Viton A (85/15)	Plastic explosive of the 'LX' range
PBX		Plastic Bonded Explosive	A range of stable, high-power explosives; composed of a secondary explosive such as PETN, RDX, TATB or HMX, and a plastic or synthetic rubber binder
PBXN		Plastic bonded explosives with additives	A range of pressed, cast and extruded explosives based on RDX and HMX, also containing Nylon and other polymers. Used in naval ammunition
PBXN-5	US	HMX/fluroelastomer (95/5)	
PBXN-106	US	RDX/Polyurethane	
PBXC-303		PETN/Silicone resin (80/20)	Injection moulded
PE		Plastic explosive	
PE-2	UK	RDX/plasticiser (88/22)	Yellow/brown colour; Vaseline-based plasticiser

Name or designation	Country	Composition	Remarks
PE-3A	UK, Pakistan	RDX/plasticiser (88/22)	Black colour; oil-based plasticiser
PE-4	UK, S Africa	RDX/plasticiser (88/22)	White colour; lithium stearate-based plasticiser
PE-4A	Portugal	RDX or PETN-based	
PE-9	S Africa	RDX/binder (90/10)	Copy of US C4
Pentastit	Various	PETN/wax (93/7)	Desensitised PETN
Pentolite	Various	PETN/RDX (50/50)	Proportions may vary
Pentrit, Pentrita, Pentrite, Pentyl	Various	PETN	Alternative names for PETN; used mainly in Europe
PEP	Former Yugoslavia	PETN-based plastic explosive	May also contain RDX
Pertite	Italy	Picric acid	
PETN		Pentaerythritol tetranitrate	Powerful explosive used in detonating cords, detonators and boosters
PETRIN	US	Pentaerythritol trinitrate	
PETS	US	Pentaerythritol tetrastearate	
PG	Portugal	RDX-based plastic explosive	
Picratol	US	Picric acid/TNT (52/48)	Proportions may vary; see also MAT
Picric acid		Trinitrophenol	A secondary explosive used extensively in the First World War
Picrite		Nitroguanidine	Normally used in mixtures with other explosives
Plastic explosive or plastique			A generic term for mouldable high explosives
PLE	US	Picatinny Liquid Explosive	Based on sensitised Nitromethane
PLX	US	Nitromethane/sensitiser	Stands for Picatinny Liquid Explosive
Primasheet 1000	UK	PETN-based sheet explosive	Approx 63% PETN
Primasheet 2000	UK	RDX-based	Flexible sheet explosive. Approx 88% RDX
PVV-5A	Russia	RDX/plasticiser (approx 80/20)	Plastic explosive for demolitions and some ordnance
PVV-7	Russia	RDX/Al/wax (72/17/11)	
RDX		Cyclotrimethylenetrinitramine	Stands for Research Department Explosive
RX-04-BA, 09-CB, 05-DE, 04-P1	US	HMX-based	Plastic explosives of the 'LX' range
Schneiderite	Russia/France	Ammonium Nitrate/ Dinitronaphthalene	Normally 88/12. WWII secondary explosive
SEMTEX H	Czech Republic	RDX/PETN (proportions vary)	Plastic explosive, also available commercially
Shimose	Japan	Picric acid	The Japanese term for picric acid
Shoeiyaku	Japan	PETN	The Japanese term for PETN
Shokamen	Japan	Nitrocellulose	The Japanese term for NC
Shotoyaku	Japan	AN/TNT	The Japanese term for Amatol
Shouyaku	Japan	RDX	The Japanese term for RDX
SX-1	UK	PETN-based sheet explosive	See Primasheet 1000
SX-2	UK	RDX-based sheet explosive	See Primasheet 2000
T	Various	TNT	Abbreviation for trotyl or TNT
T-4	France/Italy/ Spain	RDX	
TATB		Triaminotrinitrobenzene	Used in plastic and castable HE mixtures
TD-	Russia	TNT/Dinitronapthalene	Various compositions
Tetrazene or Tetracene	Various	Tetrazolyl guanyltetrazene hydrate	Primary explosive
Tetryl		Trinitrophenylmethylnitramine	Used mainly in boosters
Tetrytol	US	Tetryl/TNT (70/30)	Proportions may vary
TG-20, 30, 40, 50	Russia	TNT/RDX	Various compositions; the figure represents the approximate percentage of TNT
TH-50	N Korea	TNT/RDX (50/50)	
TNRS	Various	Lead Styphnate	Alternative designation for Lead Styphnate
TNT		Trinitrotoluene	Secondary explosive widely used in munition fillings
TORPEX	UK/US	RDX/TNT/Al/wax (approx 41/40/18/1)	Used mainly in bombs and torpedoes
Trialenes	Germany/UK/US	RDX/TNT/Al	A range of munition fillings used for bombs and torpedoes during the Second World War

Name or designation	Country	Composition	Remarks
Trilita, Trilite	Various	TNT	Terms for TNT used in Argentina, Italy and Spain
Trinolo, Tritolo	Italy	TNT	Italian names for TNT
Tritonal	US	TNT/Al (80/20)	Used as a filler for bombs and projectiles
Trotil, trotyl	Various	TNT	Term used in Russia and much of Europe
TX50	Former Yugoslavia	TNT/RDX (50/50)	
X-0242	US	HMX/polymer (92/8)	One of the PBX range

SOLID PROPELLANTS

The following table lists some of the abbreviations, terms and compositions used for both gun and rocket solid propellants.

See also:

- Background information on propellants
- Separate entry on *Liquid propellants* in this section
- Separate entry on *Military high explosives* for more information on the explosive constituents of propellants
- Russian propellant designators, listed in a separate entry in this section.

Name or designation	Composition	Remarks
Additives	Various	Used to stabilise, plasticise, cool, lubricate and reduce flash in propellant compositions
Albonite	NC/DINA	Double-base propellants made using Dioxyethylnitramine Dinitrate (DINA) in place of NG
Ammonium Perchlorate (AP)		An oxidiser used primarily in composite propellants
Ballistite	NG/NC	An early double-base propellant
Ball powder	NC/additives	Propellant with small spherical grains; used mainly in small-arms ammunition
BGO, BGY, BIC, BID, BIE, BIM, BIP, BLB, BLC	NG/NC based	Castable double-base propellants made in the US
Black powder	Potassium Nitrate/ Charcoal/Sulphur	Also known as gunpowder; used in various proportions, mainly for ejection charges
Cambrite	NG/Potassium Nitrate based	Obsolete smokeless powder composition
Cannonite	NC-based	Obsolete smokeless powder composition
CBS-128 to 162		US composite rocket propellants
CC	RDX-based	US abbreviation for 'Cyclonite Cannon' propellants
CDB	NG/NC	Stands for Cast Double-Base
CDT	NG/NC	US castable double-based propellant
CMCDB	NG/NC/AP/Al	Stands for Composite Modified Cast Double-Base; may also contain some HMX and other additives
Composites	AP/polymer/additives in various compositions	Modern rocket propellant using oxidiser and energetic material in a polymer matrix; see CTPB, HTPB, PIB and PU
Cordite	NG/NC/stabiliser (58/37/5)	Proportions vary
CTPB	Carboxy-Terminated Polybutadiene	Polymer used in rubbery composite propellants
Disc powder	Various	Propellant grains formed into small discs
Double-Base (DB)	NG/NC/additives	Propellant in which NG and NC are the only explosive constituents
EMCDB	CDB with polymer	Stands for Elastromer Modified Cast Double-Base
Energised propellant	Various	Propellant containing a significant proportion of RDX
ERLA		An epoxy compound used as a binder in some composite propellants
Flashless propellant	Normally: NG/NC/NQ/additives	Triple-base propellant containing a high proportion of NQ or other Nitrogen-generating compound
FNH	NC/additives	Single-base propellant used in artillery ammunition
HTPB	Hydroxy-Terminated Polybutadiene	Polymer used in rubbery composite propellants
Hybrids	See CMCDB	A term for modified double-base propellants
IMR	NC/additives	US single-base propellant
LOVA Propellant		LOVA stands for low-vulnerability ammunition; uses HE composite propellants in powder form
M1, M6, M10,	NC/additives	US single-base propellants
M2, M5, M8, M18,	NG/NC/additives	US double-base propellants
M30, M31	NG/NC/NQ/additives	US triple-base propellants

Name or designation	Composition	Remarks
MAPO	MethylAziridine Phosphine Oxide	Binder used in composite propellants
N (propellant)	NG/NC/NQ/additives	Triple-base propellant used in artillery ammunition
NC	Nitrocellulose	HE used in propellant compositions
NG	Nitroglycerine	HE used in propellant compositions
NH (propellant)	NC/additives	Single-base propellant used in artillery ammunition
NNN (propellant)	NG/NC/additives	Double-base propellant used in small-arms ammunition
NPP (propellant)	NG/NC/additives	Double-base propellant used in small-arms ammunition
NQ	Nitroguanidine	Also known as Picrite; a low-temperature explosive used mainly to reduce flash in triple-base propellants
NQ (propellant)	NG/NC/NQ/additives	Triple-base propellant used in artillery ammunition
NRN (propellant)	NC/additives	Single-base propellant used in small-arms ammunition
PBAA	Polybutadiene-Acrylic Acid	A co-polymer used in composite propellants
PBAN	Polybutadiene-Acrylonitrile	A co-polymer used in composite propellants
PIB	Polyisobutylene	Polymer used in early plastic composite propellants
Plastisol		Composite or DB propellant with polymer dissolved in plasticiser
PS	Polysulphide	Polymer used in some composite propellants
PU	Polyurethane	Polymer used in rubbery composite propellants
Pyroxilin	NC/additives	Single-based propellant used by Russia
Ribbon powder/propellant	Various	Propellant grains formed into thin flat sheets
Single-base	NC/additives	Propellant in which NC is the only explosive
Triple-base	NG/NC/NQ/additives	Propellant in which NG, NC and NQ are the explosive constituents; used mainly for larger-calibre ammunition to reduce flash and extend barrel life
Tube/tubed propellant	Various	Propellant grains incorporating one or more small tubes to increase surface area

LIQUID PROPELLANTS

The following table lists some of the terms and designations used with liquid propellants.
See also:

- Background information on propellants
- Separate entry on *Solid propellants* in this section
- Russian propellant designators, listed in a separate entry in this section.

Term	Meaning/Remarks
AK-20, -20F, -20I, -20K	Russian designations for mixtures containing 80% Nitric Acid and 20% Dinitrogen Tetroxide, with other additives
AK-27I, -27P	Russian designations for mixtures containing 73% Nitric Acid and 27% Dinitrogen Tetroxide, with other additives
Bipropellant	The use of combined oxidiser and fuel to create a propellant effect
Catergol/catergolic	A fuel requiring a catalyst for decomposition
Hydrazine	A monopropellant compound, decomposed using a catalyst
Hydrogen Peroxide	A monopropellant compound
Hypergol, hypergolic	Bipropellants which ignite spontaneously when mixed
IPN	Abbreviation for IsoPropylNitrate (monopropellant)
IRFNA	Inhibited Red-Fuming Nitric Acid. A common hypergolic oxidiser, often used with UDMH. Contains Nitric Acid, Dinitogen Tetroxide and a small proportion of Hydroflouric Acid as a corrosion inhibitor. May also contain Sulphuric Acid
Iso-propylnitrate	A monopropellant compound. Also used in some FAE weapons
JP	'Jet Propellant' (US)
JP-1, -2, -3, -4, -5	US hydrocarbon rocket fuels

Term	Meaning/Remarks
JP-X	JP-4/UDMH (60/40) fuel (US)
LOX	Abbreviation for Liquid Oxygen
MAF	US abbreviation for 'Mixed Amine Fuels'
Monergol	Another term for a monopropellant
Monoaminoxylene	See Xylidine
Monopropellant	A single material used for a rocket propellant
Methanol	Alcohol used as a fuel
Nitromethane	A monopropellant compound, decomposed on ignition
Non-hypergolic	Bipropellants which require a source of ignition once mixed
Oxygen	Normally liquified for use in early rocket motors
RFNA	Red-Fuming Nitric Acid. An oxidiser composed of 80–85% Nitric acid mixed with Dinitogen Tetroxide and water
TG-02	Russian designation for TONKA-250 amine-based fuel
TONKA	German/Russian term for amine-based rocket fuel
TONKA-250	German/Russian fuel: mixture of Xylidine and Triethylamine (57/43)
TONKA-259	German/Russian fuel: mixture of Xylidine and Triethylamine (50/50)
Triethylamine	Liquid compound formerly used as a rocket fuel
UDMH	Unsymmetrical DiMethylHydrazine. A common hypergolic fuel, normally used with IRFNA
WFNA	White Fuming Nitric Acid. An oxidiser composed of around 97% Nitric acid mixed with Dinitogen Tetroxide and water
Xylidine	Monoaminoxylene. Toxic liquid compound formerly used as a rocket fuel

TYPES OF UNEXPLODED ORDNANCE

Bombs
Booby traps
Chemical weapons
Demolition charges
Fuzes
Grenades
Mines
Missiles
Mortar bombs
Projectiles
Rockets
Submunitions

Russian bombs in their packing crates in Iraq (Colin King) 0573251

An unexploded OFAB-250-275 in Kosovo (Colin King) 0074679

An unexploded US Mk 84 bomb in Kosovo. Note the tail section is missing (Colin King) 0629697

NAAMAN-250 is the Iraqi designation given to the Chilean CB-500 cluster bomb, designed to carry the Chilean PM-1 bomblet (Colin King) 0573255

GBU-27 combines the Paveway III guidance system (nose and tail assemblies) with a BLU-109 warhead (Lockheed Martin) 0130674

Mk 84 bombs in Iraq
(Colin King)
1041194

BOMBS

GENERAL

Description

Bombs are normally characterised by the presence of one or more suspension lugs (see *Notes*), stabilising fins and a fuzing system. They are basically free-fall munitions, although add-on guidance systems are increasingly common; some also incorporate rockets for the terminal phase of flight in order to maximise penetration. Bombs generally weigh between 50 and 5,000 kg, though there are some examples outside this range; the weight category of a bomb is only an approximation of the overall weight and gives no indication of the size of the payload or explosive charge. Most casings are made from cast or sheet steel which, particularly on naval weapons, may be covered by a thermal coating (often recognisable by its rough, dimpled appearance). Many of the newer 'low-drag' bombs have a distinctly sleeker appearance than the older types, with cigar-shaped bodies and small tail fin assemblies.

The most common types of HE bomb are General Purpose (GP) and penetration, sometimes known as Armour-Piercing (AP), Semi-Armour-Piercing (SAP) or 'concrete-piercing'. Submunition carriers, or 'cluster bombs', may contain HE bomblets, mines, incendiaries, chemical fills, markers, illuminants and smoke. Other types of bomb include fragmentation, incendiary or fire bombs and blast bombs containing Fuel-Air Explosive (FAE); some countries still retain nuclear and chemical bombs in their inventories. 'Low Collateral Damage Bombs' (LCDB), with greatly reduced fragmentation effects, are also entering service.

Since most bombs are broadly similar in shape, the external appearance is rarely sufficient to confirm which category a bomb belongs to; the only really reliable recognition features are the markings. Other signatures in the impact area, such as effects, or components of bombs that have functioned, may also aid recognition.

Fuzes are generally nose-mounted or tail-mounted (sometimes both), though some bombs (notably Second World War German types) have transverse fuzes mounted in the side of the bomb body. It is common for bombs to have standard fuze wells designed to accept a range of fuzing options, making it critical to identify the fuze correctly if a render-safe procedure is to be applied.

With optional fuzes, gliding wings, guidance systems and retard tail assemblies, modern bombs are increasingly modular, which can make positive identification even more difficult.

Operational details

Typical operation

The initial stage of arming is normally completed immediately before deployment from the aircraft but, on the rare occasions where this has not been done, an entire load or 'stick' may be found unexploded. Electrical fuzes are normally activated by passing a charge down the umbilical cord that connects the aircraft with the bomb; with mechanical fuzes, a lanyard may be used to withdraw a safety feature as the bomb is dropped. A device connected to the fuze, such as a wind-driven vane, is often used to initiate the final arming action by driving a mechanism or powering an electrical circuit; this may also cause failure if the drop speed or altitude is insufficient. Bomb fuzes vary immensely in appearance and design, ranging from simple mechanical actions to complex electronic systems; some have several components, linked by a wiring loom, to initiate a series of events. Increasingly, add-on guidance systems (such as the US 'Paveway' series) are being used with standard bomb bodies to produce 'precision-guided bombs' for increased accuracy and reduced collateral damage. These either seek a laser-designated target or use inertial navigation assisted by a Global Positioning System (GPS). Some bomb tails incorporate retarding mechanisms such as chutes or paddles, which may be deployed using explosive bolts, ejection charges or powerful springs. A few penetration bombs incorporate a rocket motor to accelerate the warhead once it has been stabilised (normally using a parachute). Carriers may also have ejection charges or central bursters and sometimes use linear cutting charges along the bomb casing.

EOD considerations

- It is critical that bomb and fuze are correctly identified before taking EOD action
- Protective works should be considered before demolition
- Thermal coatings will attenuate the power of demolition charges
- Bombs may incorporate hazardous secondary components such as rockets, ejection charges and powerful springs
- Nose fuzes are often badly damaged during impact and may not be identifiable
- Tail sections may break away during impact, altering the appearance of the bomb
- Tail sections may conceal a fuze but may be badly damaged and difficult to remove
- Special demolition methods and precautions are needed for large submunition carrier bombs
- Large carrier bombs may contain HE linear cutting charges and/or central bursters.

Notes

The gap between suspension lugs can be a useful aid to identification. Former Warsaw Pact states, and those using Russian-designed weapons (such as Egypt and Iraq), tend to use bombs with 250 mm lug spacing. NATO weapons normally have suspension lugs either 356 or 762 mm apart. For information on markings and colour codes, see the *Identification* section.

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Kosovo, 1999. Bombs make larger craters in moist, fertile soil or clay than in dry sandy, chalky or rocky ground (Colin King) 0532012

A classic unexploded bomb entry hole, 6 m deep made by a 2,000 lb BLU-109/B in Kuwait
(Colin King)
0074680

Iraq, 2003. Sometimes the ejected earth falls back into the crater, making it difficult to judge the size
(Colin King)
0573252

BOMB CHARACTERISTICS

Charge proportions

The casing, tail and fuzing system normally constitute a substantial proportion of a bomb's weight; for example, a US Mk 84 general purpose bomb weighing 894 kg actually contains 428 kg of HE (just under 48 per cent). The major exceptions are Low Collateral Damage Bombs (LCDB), which may use lightweight composite casings. The following table gives an indication of the charge to weight ratio for different types of bomb, allowing a rough estimate of explosive content to be made from the overall weight category of a bomb.

Bomb type	Typical charge to weight ratio	Examples US	Russian
High capacity	75–80%	BLU-82 'Daisy cutter'	FAB-1500 to 9000
General purpose	40–60%	Mk 82, 83, 84	FAB-250 to 500
Semi-armour piercing and concrete-penetrating	40%	BLU-109/B	BETAB bombs
Fragmentation	30%		OFAB-100 to 500
Armour piercing	10–20%	BLU-116/B	BRAB-200 to 1000

Entry holes

The diameter of the entry hole from an unexploded bomb is normally around 50 mm greater than that of the bomb casing. The following table is an approximate guide to entry hole size and penetration in fertile soil. Penetration may be significantly reduced in dry, sandy or rocky terrain, with no entry hole visible in loose sand. When bombs enter the ground obliquely, it is not unusual for them to follow a curved path and return to the surface, leaving both an entry and an exit hole.

Bomb type	Typical bomb casing diameter (mm)	Typical entry hole diameter (mm)	Typical penetration depth (m)
50 kg	180–200	230–250	3.7
100 kg (high drag)	230–270	280–320	4.6
250 kg (high drag)	300–340	350–390	6
250 kg (low drag)	260–300	310–350	8
500 kg (high drag)	410–460	460–510	9
500 kg (low drag)	330–380	380–430	10.5
1,000 kg (high drag)	480–610	530–660	11
1,000 kg (low drag)	440–480	490–530	12
2,000 kg (high drag)	660–810	710–860	12

Camouflets

Sometimes, superficial signatures (such as an entry hole and detached components) may suggest that a bomb failed to explode, whereas it has actually penetrated deep into the ground and detonated to produce an underground chamber. This effect, known as a 'camouflet', is normally indicated by unusual characteristics around the entry hole, such as cracks or excessive heave, and in nearby structures that have collapsed or show evidence of a sub-surface shockwave. The presence of steel fragments or the inability to locate a single signature using a metal detector may also indicate a camouflet.

Crater sizes

The following table gives an indication of the size of crater usually produced by GP bombs. Craters are larger in moist fertile ('heavy') soils than in dry sandy, chalky or rocky ('light') soils. Loose sand may fill craters to leave little or no indication of an explosion. Crater size and 'earth shock' are also effected by the depth at which detonation takes place, which is why many impact fuzes incorporate a short delay option.

Bomb size (GP)	Surface: width × depth (m)		Buried: width × depth (m)	
	Heavy soil	Light soil	Heavy soil	Light soil
50 kg	2.75 × 0.9	1.65 × 0.55	6 × 1.8	3.6 × 1.1
100 kg	3.25 × 1.2	2 × 0.75	7.5 × 2.4	4.5 × 1.45
250 kg	4.5 × 1.5	2.7 × 0.9	10 × 3	6 × 1.8
500 kg	5.5 × 1.8	3.3 × 1.1	13.7 × 3.7	8 × 2.2
1,000 kg	8 × 2.4	4.8 × 1.5	17 × 4.9	10 × 3
2,000 kg	9 × 2.7	5.5 × 1.6	19.5 × 5.5	11.7 × 3.3

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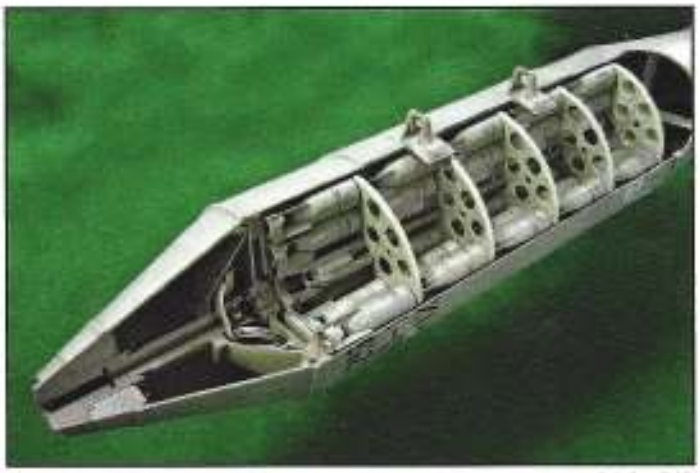
British BL-755 cluster bombs (Colin King) 1041013

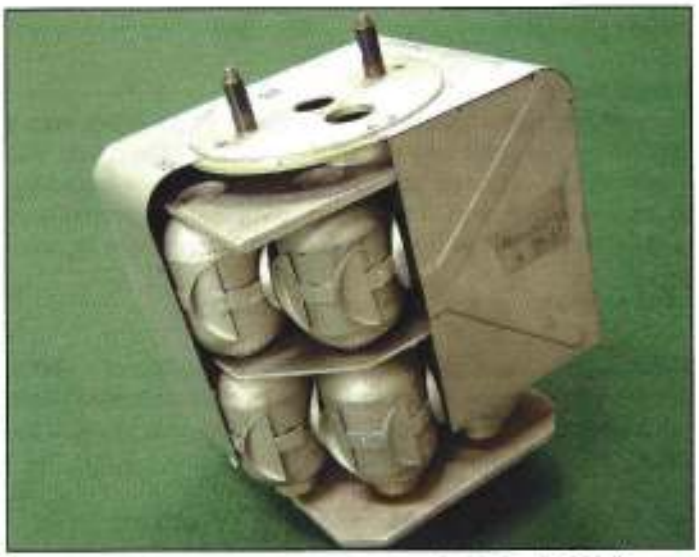
The badly damaged body of a British BL 755 cluster bomb in Kosovo, with casing stripped away and most of the 147 bomblets still in place; cluster bombs in this condition are very dangerous and difficult to demolish (Colin King) 0074258

CBU-89/B was the cluster bomb used during the Gulf War to dispense 'Gator' mines. A similar dispenser is used for the CBU-87/B cluster bomb, which carries 202 BLU-97/B bomblets (Colin King) 1342187



The Russian RBK-250-275, sectioned to show the payload of AO-1SCh bomblets (Colin King) 1374327

The Russian KMG-U is a versatile dispenser used with submunitions and mines (Colin King) 1121271



The container for AO-2.5RT submunitions, used with the KMG-U dispenser (Colin King) 1342176

The US Mk 7 'Rockeye' dispenser (Colin King) 1289958

CLUSTER BOMBS

Description

Air-delivered submunitions can be dropped from either aircraft dispensers or cluster bombs. Aircraft dispensers (such as the British JP 233 German MW-1 and Russian KMGU) are pods which remain attached to the aircraft as the submunitions are dropped, while cluster bombs are dropped in the same way as a normal bomb, but open at some point during their descent to disperse their payload.

Cluster bombs generally have proximity or delay nose fuzes, with the bulk of the bomb body forming a cargo area containing the payload. The cargo area may incorporate ejection charges attached to the fuze or running through the bomb body, or may use linear cutting charges to cut open the casing. In some bombs, such as the Russian RBK-250-275, an ejection charge is located immediately behind the fuze and forces a pusher plate to eject the payload through the rear of the bomb body.

Tail assemblies are normally simple, but may include powerful springs to deploy fins. Submunitions are packed together tightly, and may have spacers or packing pieces between them; these can be an aid to identification in and around the impact area. Bomblets normally incorporate separate arming systems, and are therefore relatively safe while contained in the bomb body.

The same cluster bomb body may be used with different submunitions. In the Russian system, the weapon is marked with the cluster bomb designation followed by that of the submunition, while US 'SUUs' (Suspended Underwing Units) containing different submunitions are given unique 'CBU' (Cluster Bomb Unit) designations. For more information on cluster bomb payloads, see the entries on *Submunitions* in this section.

Operational details

Typical operation

The US Mk 7 'Rockeye' cluster bomb, used extensively during the first Gulf War, is representative of several US systems. The turbine-driven Mk 339 time fuze has been replaced with the FMU-140/M (also used with the Gator mine dispensers), which is a self-powered, solid-state unit using Doppler radar to determine height. The FMU-140/M can be programmed for one of 10 opening height settings between 90 and 900 m. On activation, a linear-shaped charge splits the bomb casing into two halves, releasing the bomblets over the target area. In Russian RBK cluster bombs, a nose-mounted electromechanical time fuze is used to fire an ejection charge in the nose cone, shearing off the tail assembly and pushing the payload out of the rear of the bomb body. The British BL-755 uses pyrotechnic gas generators to first split the outer casing, then inflate small bags to eject the bomblets sideways. The original BL-755 uses a delay fuze while the 'Improved' version uses a radar proximity fuze.

Once submunitions have been ejected from a cluster bomb, their dispersal is uncontrolled, with the size of the impact pattern increasing with the bomb opening altitude and rate of spin. The forward motion of the bomb creates a cigar-shaped impact pattern of submunitions on the ground, near which the empty bomb container may be found. Occasionally, the cluster bomb will fail to open. Since the submunitions are generally unarmed and well protected, they will not normally detonate as the bomb impacts; however, access can be difficult if they are partially buried and they may be left in a hazardous condition.

EOD considerations

- An empty cluster bomb casing or spacers may indicate the presence of unexploded submunitions nearby
- Proximity fuzes should never be approached from the front
- The presence of ejection charges and linear cutting charges should be considered
- Incomplete demolition often results in the dispersal of submunitions, some of which may become armed
- Unopened cluster bombs require special demolition techniques to ensure the destruction of all submunitions
- Nose fuzes are often badly damaged during impact and may not be identifiable
- Tail sections may incorporate powerful springs, which can cause injury
- Thermal coatings will attenuate the power of demolition charges.

Example	British BL-755	Russian RBK-250-275	US Mk 7 'Rockeye' dispenser
Diameter:	420 mm	325 mm	335 mm
Length:	2.45 m	2.12 m	2.34 m
Weight:	277 kg	275 kg	222 kg
Nomal payload options:	147 BL-755 bomblets	150 AO-1SCh, or 42 PTAB-2.5M	247 'Rockeye' bomblets, or 60 Gator mines

Notes

All of the cluster bombs and submunitions described in this entry are banned under the terms of the Convention on Cluster Munitions (CCM). Diagrams showing Russian cluster bombs are included in the *Russian Federation Bombs* entries; see also entries on national production of cluster bombs.

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An unexploded US Navy Mk 82 bomb in Iraq. This bomb has a thermal coating, which will attenuate the power of a demolition charge (Colin King)
0573253

Old 'high drag' US 1,000 lb and 2,000 lb bomb bodies (Colin King) 1041014

A Russian FAB-500ShN with parachute deployed (Colin King/DEODS)
0529598

Sectioned South African GP bombs. Centre: note the electrical conduit linking the nose and tail fuze wells with the charging socket between the suspension lugs. The left and right hand bombs have additional ball-bearing fragmentation lining the casing
(Colin King)
0573254

GENERAL-PURPOSE HE BOMBS

Description

During the Second World War, a wide variety of HE bombs were built for specific roles, and many of these categories are still reflected in the range used by the Russian Federation (see *Russian Federation Bombs*). However, while some 'special' warheads are in use, the majority of modern HE bombs could be classified as either General Purpose (GP) or penetration bombs, which are covered in a separate entry.

General-Purpose (GP) bombs are designed to offer a good compromise between blast, fragmentation and penetration. The HE filling may constitute up to half the weight of a GP bomb. They have largely replaced purpose-built fragmentation bombs, which have a thicker steel body and therefore a lower charge-to-weight ratio (about one third). Where blast is the desired primary effect, large bombs are built with relatively thin casings and high charge-to-weight ratios; these are sometimes known as high-capacity bombs.

Some of the older GP and fragmentation bombs had a thick ring of steel welded around the curved nose section; this is known as a 'Kopf Ring' and was designed to prevent skipping and excessive penetration on impact. Most modern bombs are designed for external carriage on the aircraft and are therefore designed to be as aerodynamic as possible. These 'low-drag' bombs have a sleek shape, which can make them difficult to distinguish from penetrators and other GP bombs. Some older Russian designs had pre-fragmented bodies, while some newer bombs have composite bodies with ball bearings set in a plastic matrix.

GP bombs are generally fitted with impact fuzes in the nose and/or tail, but will also accept a variety of other fuzes (such as proximity, short delay, long delay or multi-function) to suit specific roles. Transverse fuzes were used extensively in Second World War German bombs, but are rare today. Where tail fuzes are fitted to bombs, these are often concealed by the tail assembly, which may complicate or completely prevent access to the fuze when damaged on impact. In some cases, impact fuzes are fitted with stand-off probes to detonate the bomb above the ground, although modern versions tend to use electronic proximity fuzes to achieve this effect.

Optional retarding tail assemblies are often available for low-level attack and may incorporate secondary hazards such as ejection charges and powerful springs. Several types of modern bomb can be modified for precision attack using add-on guidance units (such as the 'Paveway' series) which include new nose and tail assemblies. Thermal insulation coatings are used on some bombs (generally those in naval service) and are normally recognisable by their rough texture. A recent innovation is the development of the 'Low Collateral Damage Bomb' (LCDB), which aims to minimise unpredictable effects of long range fragmentation by substantially reducing the HE charge, or by eliminating the heavy steel casing associated with most GP bombs.

Operational details

Typical operation

The first stage of arming normally occurs during, or immediately before, deployment from the aircraft. For electrical fuzes, this is generally achieved by passing a pulse along an umbilical cable connecting the aircraft to the bomb; mechanical fuzes may use a lanyard to withdraw a safety device as the bomb is dropped. The final arming action then occurs while the bomb is in flight, and may cause the weapon to fail if the drop speed or altitude is insufficient. Modern bombs tend to use electronic fuzes, often powered by a wind-driven generator, though mechanical systems are still used as well. In many cases, a GP bomb body can be fitted with a variety of tail and guidance options, which may also be linked into the fuzing system. Some bomb tails incorporate retarding mechanisms such as chutes or paddles, which may be deployed using explosive bolts, ejection charges or powerful springs. Most GP bombs are fuzed to function either on impact (to maximise blast and fragmentation) or short delay (to maximise ground shock in order to destroy structures and earthworks). Some modern electronic fuzes, such as the British Multi-Function Bomb Fuze (MFBF), have a range of options and may default automatically from one to another; this makes them unpredictable and therefore extremely hazardous to EOD personnel.

EOD considerations

- It is critical that bomb and fuze are correctly identified before EOD action
- Low-drag bombs tend to look alike, making markings important to identification
- Recognition of anti-disturbance, electronic multifunction and long-delay fuzes is a priority
- Nose fuzes are often badly damaged during impact and may not be identifiable
- Tail sections may conceal a fuze but may be badly damaged and difficult to remove
- Tail and guidance sections may incorporate hazardous components such as ejection charges and powerful springs
- Protective works should be considered before demolition
- Thermal coatings will attenuate the power of demolition charges.

Typical specifications

Example	US Mk 82	Russian FAB-500ShN	US Mk 84
Diameter:	273 mm	450 mm	460 mm
Length:	2.21 m	2.19 m	3.38 m
Weight:	241 kg	518 kg	894 kg
HE weight:	89 kg	218 kg	428 kg
HE type:	Tritonal, Minol, PBXN-109 or H-6	TNT	Tritonal or H-6

Notes

Diagrams showing Russian bombs are included in separate entries; see also entries on national production of HE bombs. For more information on LCDB, see *Other bomb types*.

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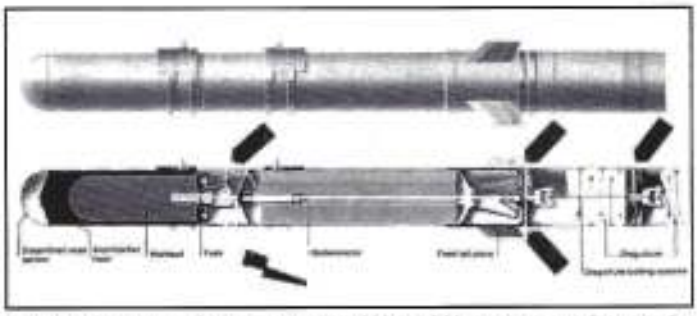
A Russian BETAB-500 concrete-piercing bomb (Colin King) 1041015

The US BLU-109/B 2000 lb penetration bomb was used against bunkers during the Gulf War. This particular bomb followed a curved path through the ground to emerge on the surface, leaving both an entry hole and an exit hole. Note the arming socket on the side and the remains of a yellow hazard band; the guidance unit and tail are missing (Colin King) 0074255



The French Duandal (US designation BLU-107/B) incorporates a large rocket motor 0504477

The effects of a BLU-109 warhead inside a hardened aircraft shelter, having penetrated more than 2 m of reinforced concrete
(Colin King)
0629699

PENETRATION BOMBS

Description

In the past, penetrating bombs have been catagorised as Armour-Piercing (AP), Semi-Armour-Piercing (SAP) or 'concrete-piercing' (a term favoured by Russia). Although these terms are still used, there is often little difference between the weapon types, all of which are designed to penetrate and demolish a hardened target. The term 'armour-piercing' is also misleading since these bombs are more often used against buried or reinforced structures such as hardened aircraft shelters and bunkers.

Conventional penetrating bombs are normally streamlined 'low-drag' shapes and have thick reinforced nose sections. They are invariably fitted with tail fuzes; these are normally impact-initiated with a short delay to allow the bomb to penetrate the target before detonation. The tail fuze is generally concealed by the tail assembly, which may complicate or completely prevent access to the fuze when damaged on impact.

Several types of modern bomb can be modified for precision attack using add-on guidance units (such as the 'Paveway' series) which include new nose and tail assemblies. The US BLU-109/B penetration bomb, for example, forms the basis of several Glide Bomb Units (GBU) when the bomb body is used as the warhead with Paveway I, II or III guidance assemblies. Thermal insulation coatings are used on some bombs, especially those for naval service, and are normally recognisable by their rough texture.

Operational details

Typical operation

The first stage of arming normally occurs during, or immediately before, deployment from the aircraft. For electrical fuzes, this is generally achieved by passing a pulse along an umbilical cable connecting the aircraft to the bomb; mechanical fuzes may use a lanyard to withdraw a safety device as the bomb is dropped. The final arming action then occurs while the bomb is in flight, and may cause the weapon to fail if the drop speed or altitude is insufficient. The tail fuze is initiated on impact, beginning a short delay to allow the bomb to pass through the protective structure and into the target area; the warhead then detonates inside the target.

For example, the US BLU-109/B (see specifications and photographs) incorporates a mechanical timer, which starts when an arming lanyard withdraws a safety clip. Another arming lanyard releases an air scoop to power the turbine generator. The mechanical timer passes current from the generator to the electronic fuze, which incorporates a further arming delay. In this case, a variety of fuzes can be used, including the US FMU-143 series, the British Multi-Function Bomb Fuze (MFBF), the Joint Programmable Fuze (JPF) and the HardTarget Smart Fuze (HTSF). Having impacted and penetrated its target, the bomb is detonated after a 60 ms delay.

Most penetrating bombs rely purely on kinetic energy to breach their target, although some (such as the French Durandal and Russian BETAB-500ShP) are rocket-assisted to increase their impact velocity. Once penetrated, a hardened structure encloses the blast and therefore enhances the explosive effects; this means that relatively small charges can have a devastating effect once inside the target. Although most penetrating bombs have short delay fuzes, some modern electronic fuzes, such as the MFBF, have a range of options (which may include long delay and anti-disturbance) and can default automatically from one to another; this makes them unpredictable and therefore extremely hazardous to EOD personnel.

EOD considerations

- It is critical that bomb and fuze are correctly identified before EOD action
- Recognition of anti-disturbance, electronic multifunction and long-delay fuzes is a priority
- Tail sections may conceal a fuze but may be badly damaged and difficult to remove
- Tail sections may incorporate hazardous components such as ejection charges and powerful springs
- Protective works should be considered before demolition
- Demolition charges should be placed well back from the thick nose section of penetrating bombs
- Thermal coatings will attenuate the power of demolition charges
- Some penetration bombs incorporate rocket motors
- These bombs may penetrate to a substantial depth in some soil conditions (see *Bomb characteristics*).

Typical specifications

Example	French Durandal	Russian BETAB-500	US BLU-109/B
Diameter:	223 mm	350 mm	370 mm
Length:	2.49 m	2.23 m	2.4 m (bomb body only)
Weight:	185 kg	477 kg	874 kg (bomb body only)
HE weight:	15 kg	75.8 kg	240 kg
Penetration:	1.5 m concrete (est)	3m soil plus 1m concrete	1.8–2.4 m concrete

Notes

Diagrams showing Russian penetration bombs are included in the separate entries; see also entries on national production of HE bombs.

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The Russian OFAB-250-270 is an old shape 'high drag' bomb. The designation denotes this as a 250 kg class bomb that actually weighs 270 kg (Colin King)
1041016

Standard packing for Russian bombs uses wooden planks held together by steel hoops. The crate opens into two halves along its length, and contains a packing note, normally in a pressed metal tab pinned to one of the wooden planks (Colin King)
0074256

AGITAB is a leaflet carrying bomb (Colin King)
1289964

Markings on the end of a bomb crate (Colin King)
1374328

A Russian RBK-250-275 cluster bomb in its open packing crate. The black markings specify the bomb designation, the payload (AO-1SCh bomblets) and their explosive fill (A-IX-2: RDX/Aluminium/wax) (Colin King)
0074257

Markings on an RBK-250 cluster bomb, showing the payload as PTAB-2.5M bomblets and the HE content as TG-50 (Colin King)
1341061

RUSSIAN FEDERATION BOMBS

The Russian Federation inventory currently includes about 65 types of aircraft bomb, with many of these held or copied by former Warsaw Pact countries or Soviet-supplied states. The bombs are designated by category, normally with black markings on the grey casing, and generally have payload or filling designators marked below the bomb type. Most have suspension lugs 250 mm apart, although single suspension lugs are also used. Russian Federation bombs are classified by weight in the following categories: 0.5, 1.0, 2.5, 10, 25, 50, 100, 250, 500, 1,500, 3,000, 5,000 and 9,000 kg. These figures only approximate to the overall weight, and give no indication of the explosive or payload weight.

In cases where the overall weight differs significantly from the weight category, the actual weight may be indicated in the designation. For example, FAB-1500-2600TS is a thick-walled 1,500 kg category general-purpose bomb which actually weighs 2,600 kg. The year of introduction may also be included as a suffix in the designation, such as M62. Other figures, sometimes known as 'drop numbers', are marked in the form of fractions in black or white; these relate to the deployment of the bomb and have no significance for EOD purposes. Foreign stocks or copies of Russian bombs may adhere to the original designation or substitute a local designation, such as the Iraqi NASR range (see *Russian Federation Bombs* diagrams).

Categories

The major Russian bomb categories are:

AO: Fragmentation bombs. AO stands for *aviabomba oskolochaya* meaning 'aerial fragmentation bomb'. There are also pellet fragmentation bombs designated (ShOAB). These bombs are intended to engage personnel, soft-skinned and lightly armoured targets. The Russian Federation inventory comprises mainly small-size AO bombs (0.5, 1.0, 2.5 and 10 kg) which are used as payloads for cluster bombs and submunition dispensers.

BetAB: Penetration bombs. BetAB stands for *betonoboynaya aviatsionnaya bomba* meaning 'concrete-piercing aircraft bomb'. These are armour-piercing bombs, designed to destroy targets heavily protected with reinforced concrete, or otherwise fortified.

FAB: General-purpose bombs. FAB stands for *fugasnaya aviabomba* meaning 'aerial demolition bomb'. The Russian Federation makes extensive use of thin-walled weapons with a high explosive-to-casing ratio. These bombs are designed to destroy targets primarily by the blast wave and have only a small fragmentation effect.

ODAB: Fuel-air bombs. ODAB stands for *obyomno-detoniruyushchaya aviatsionnaya bomba* meaning 'volume-detonation aircraft bomb'. Russia has advanced Fuel-Air Explosive (FAE) technology and has succeeded in producing reliable FAE bombs where many others have failed. The Russian bombs use a complex fuzing system to control the deployment of a parachute and the initiation sequence. In two distinct events, large burster charges are used to disperse a cloud of liquid fuel before a cloud detonator (housed in the tail unit) functions to initiate the explosion. See also the description of FAE weapons under *Other types of bomb*.

OFAB: General-purpose fragmentation bombs. OFAB stands for *oskolochno-fugasnaya aviatsionnaya bomba* meaning 'fragmentation/high-explosive aircraft bomb'. These bombs are normally high-drag weapons and are designed for use against personnel, combat material, industrial targets and other facilities. To enhance their effective range, some can be fitted with a stand-off probe attached to the fuze.

PTAB: Anti-tank bombs. PTAB stands for *protivo-tankovaya aviatsionnaya bomba* meaning 'anti-tank aircraft bomb'. These bombs are intended to defeat armoured targets such as tanks and infantry fighting vehicles. PTABs are generally 1 or 2.5 kg nominal weight, and include PTAB-1M, PTAB-2.5, PTAB-2.5M and PTAB-2.5KO. These are used as payloads for the RBK-250 and RBK-500 series of cluster bombs, as well as in submunition dispensers. The family of anti-tank bombs includes active submunitions SPBE and SPBE-D, which use a parachute system, an IR seeker and Misznay-Schardin warhead to defeat heat-emitting armoured targets from above.

RBK: Cluster bombs. RBK stands for *razovaya bombovaya kasseta* meaning 'single-use bomb cassette'. These bombs are used to dispense submunitions such as AO fragmentation bomblets and PTAB anti-armour bomblets.

ShOAB bomblet. The ShOAB-0.5 is a copy of the US BLU-26/B submunition, and is dispensed from the RBK-500 cluster bomb.

ZAB and FOZAB: Incendiary bombs. ZAB stands for *zazhigatelnaya aviatsionnaya bomba* meaning 'incendiary aircraft bomb'. These weapons are designed primarily for the destruction of installations but can also be used against personnel. There are also incendiary (napalm) aerodynamic tank containers, designated ZB. FZAB and OFZAB are HE incendiary and fragmentation HE incendiary bombs.

Miscellaneous bombs. Other Russian Federation bomb designators include:

AGITAB (*agitatsiya aviatsionnaya bomba*) meaning 'propaganda aircraft bomb'

ANAB (*aero navigatsionnaya aviatsionnaya bomba*) meaning 'air navigation aircraft bomb'.

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KAB-1500L is a laser-guided bomb which can be fitted with a 1,100 kg HE penetration warhead or a 1,180 kg HE blast warhead. Note the 'GBU' designation for export (Paul Jackson) 0051983

BRAB (*Broneboynaya aviabomba*) meaning 'armour-piercing aircraft bomb'.

DAB (*Dimovaya aviatsionnaya bomba*) meaning 'smoke aircraft bomb'.

DOSAB (*dvevnaya orientirno signal'naya aviatsionnaya bomba*) meaning 'day orientation marker aircraft bomb'.

FotAB (*fotograficheskaya aviatsionnaya bomba*) meaning 'photographic aircraft bomb'.

KhAB (*Khimicheskaya aviabomba*) meaning 'chemical aircraft bomb'.

MAB (*Mostovaya aviabomba*) meaning 'light-cased blast bomb', normally incorporating a parachute.

NOSAB (*nochnaya orientirno signal'naya aviatsionnaya bomba*) meaning 'night orientation marker aircraft bomb'.

SAB (*svetyashayasya aviatsionnaya bomba*) meaning 'illuminating aircraft bomb'.

TsOSAB (*tsvetnaya orientirno signal'naya aviatsionnaya bomba*) meaning 'coloured night marker aircraft bomb'.

Bomb type	Cyrillic marking	Role or function
AGITAB	АГИТАБ	Propaganda
ANAB	АНАБ	Aircraft navigation
AO	АО	Fragmentation (bomb or bomblet)
BetAB	БетАБ	Concrete-piercing
BRAB	БРАБ	Armour-piercing
DAB	ДАБ	Smoke dispenser
DOSAB	ДОСАБ	Day navigation marker
FAB	ФАБ	General purpose
FotAB	ФотАБ	Photoflash
FZAB	ФЗАБ	HE incendiary
KhAB	ХАБ	Chemical
NOSAB	НОСАБ	Night navigation marker
ODAB	ОДАБ	Fuel-air explosive/volumetric
OFAB	ОФАБ	HE fragmentation
OFZAB	ОФЗАБ	HE fragmentation incendiary
PTAB	ПТАБ	Anti-tank (bomblet)
RBK	РБК	Cluster bomb
SAB	САБ	Illumination
ShOAB	ШОАБ	Fragmentation (pre-fragmented)
TsOSAB	ЦОСАБ	Coloured night marker
ZAB	ЗАБ	Incendiary
ZB	ЗБ	Incendiary (napalm type)

Notes

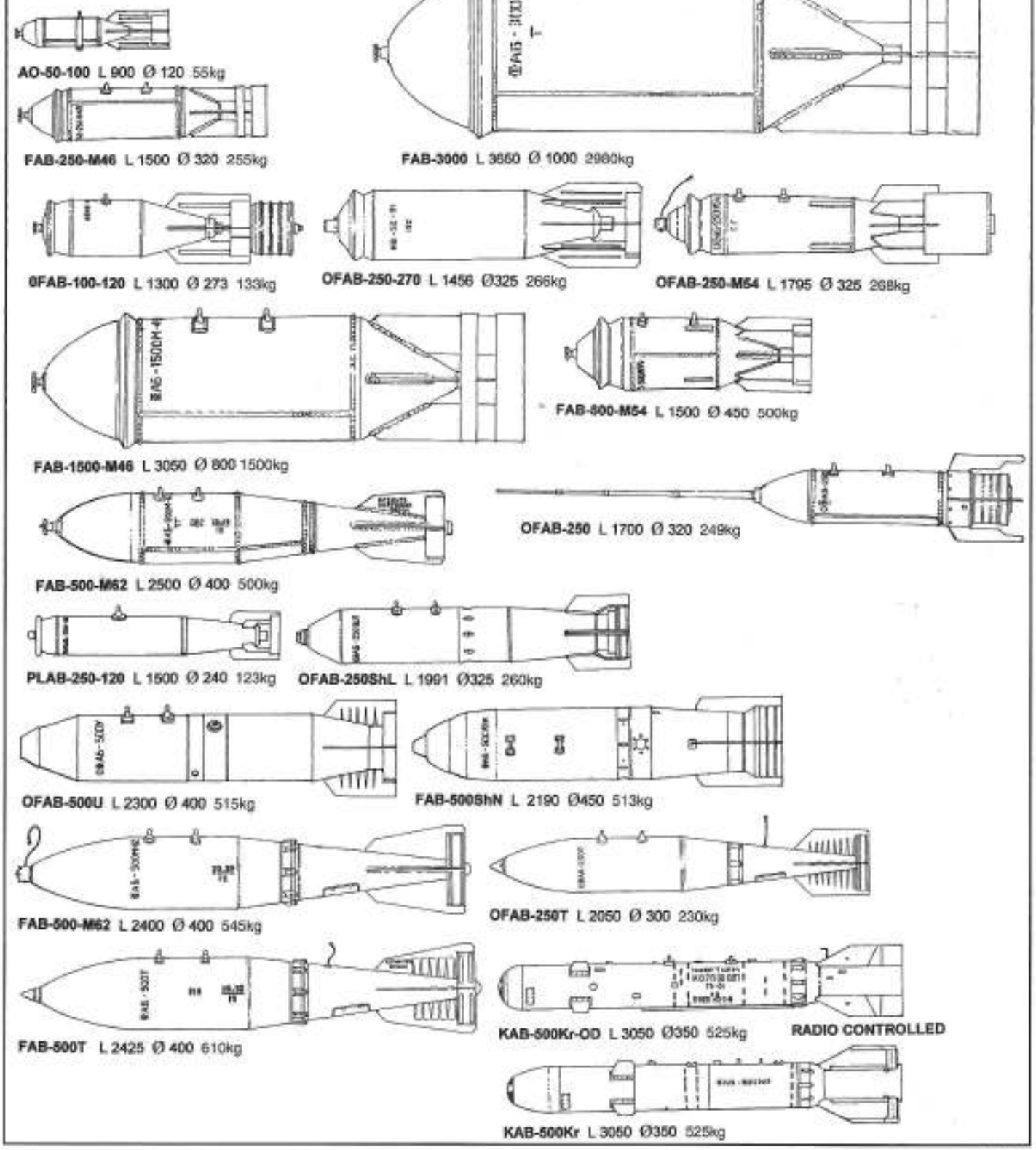
Line diagrams showing a range of Russian bombs and submunitions are included in separate entries. Russian bombs also appear in a number of other entries within the bomb section. See also *Obsolete Russian bomb colour codes*.

RUSSIAN FEDERATION BOMBS

The following diagrams show Russian Federation bombs drawn to a common scale. Some of these weapons have been adopted or copied by other nations under different designations; examples include the Iraqi NASR general-purpose bombs shown in the diagrams. The length, diameter and actual weight is shown beside each bomb. Additional specifications are given in the *Production* tables in the *Data summary* section.

RUSSIAN AERIAL BOMBS

HIGH EXPLOSIVE / FRAGMENTATION



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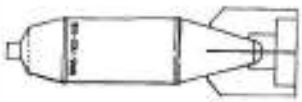
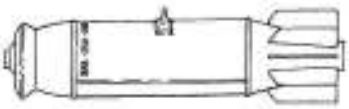
RUSSIAN AERIAL BOMBS

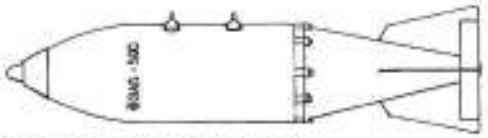
INCENDIARY / EXPLOSIVE INCENDIARY



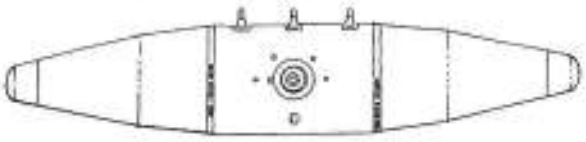
ZAB-100-105 L 1065 Ø 273 106.9kg



ZAB-250-200 L 1500 Ø 325 202kg



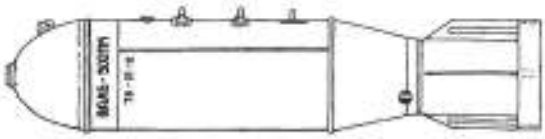
FZAB-500 L 2500 Ø 450 500kg



ZB-500ShM L 2500 Ø 500 317kg

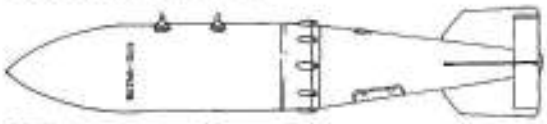
OFZAB-500 L 2500 Ø450 498kg

FUEL / AIR



ODAB-500PM L 2280 Ø 500 520kg

CONCRETE PIERCING



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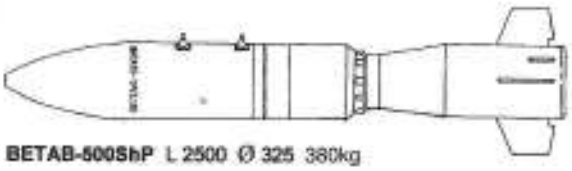

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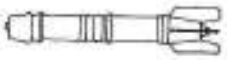
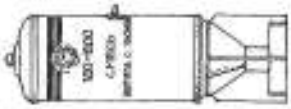
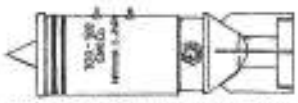


BRAB-200DS L 950 Ø 120 180kg

CHEMICAL AGENT BOMBS



100-80C (MG/L) L 1270 Ø 380 115kg



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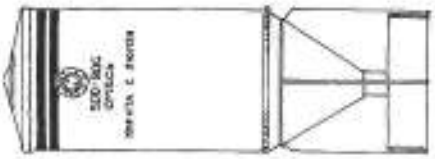

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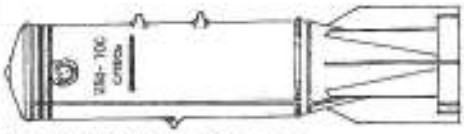
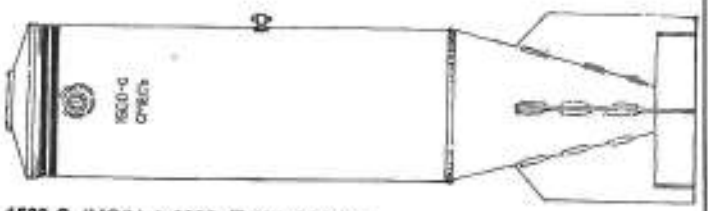
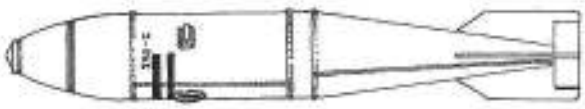


250-70C (S) L 2010 Ø 420 260kg

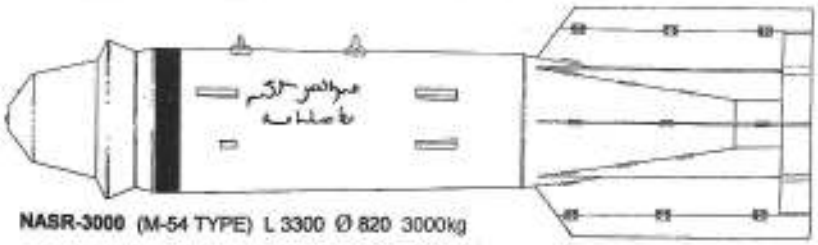


1500-C (MG/L) L 3020 Ø 680 1470kg

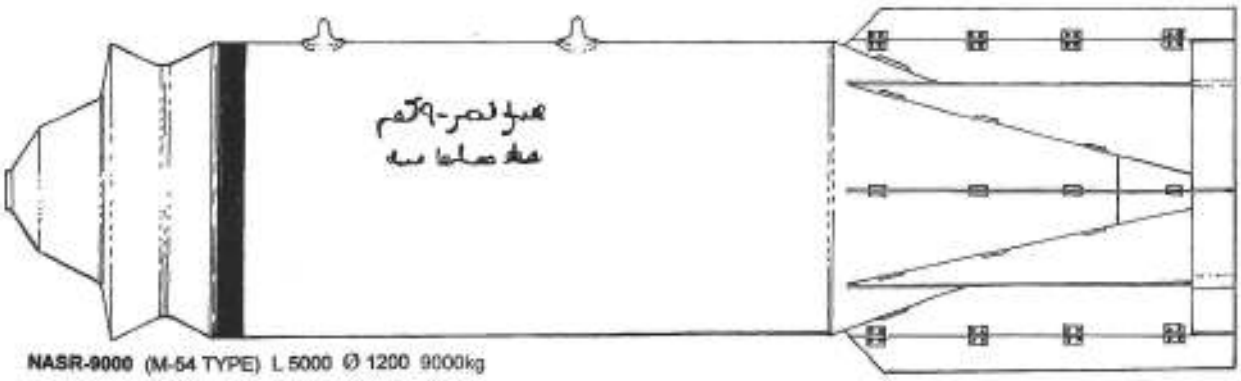


250-C (VS) L 2650 Ø 390 275kg

0529645



NASR-3000 (M-54 TYPE) L 3300 Ø 820 3000kg



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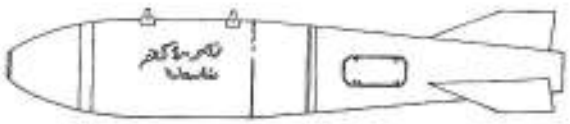
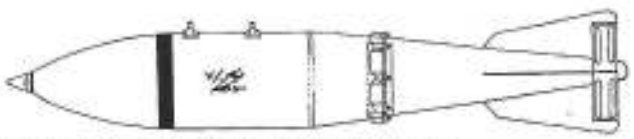
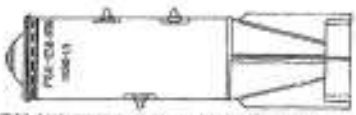


NASR-400 L 2200 Ø 406 400kg

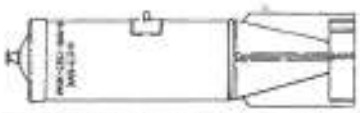


NASR-7 (FAB-500T COPY) L 2400 Ø 400 500kg

CONTAINER BOMBS



RBK-250-PTAB-1,5 L 1490 Ø 325 200kg



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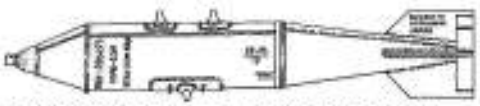
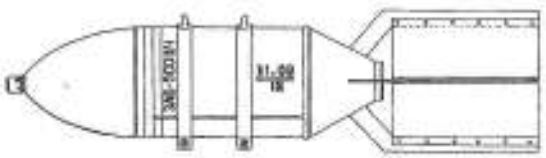
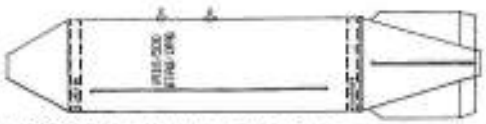


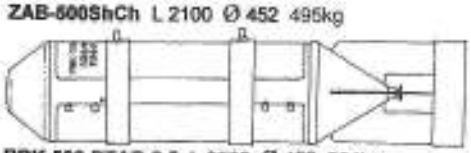
RBK-250-275-PTAB-2,5M L 2300 Ø 325 190kg



ZAB-500ShCh L 2100 Ø 452 495kg

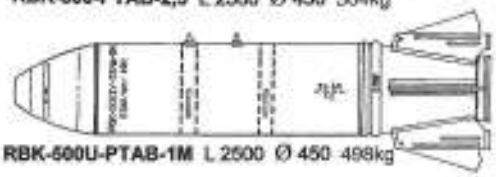


RBK-500-PTAB-SPBD L 2400 Ø 450 495kg

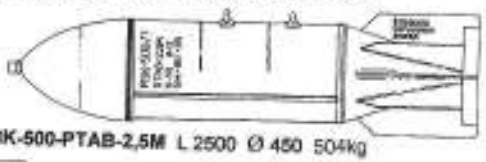


RBK-500-PTAB-2,5 L 2500 Ø 450 504kg

RBK-500U-OAB-2,5RT L 2500 Ø 450 495kg

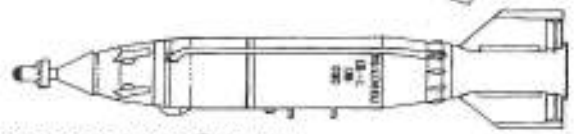


RBK-500U-PTAB-1M L 2500 Ø 450 498kg



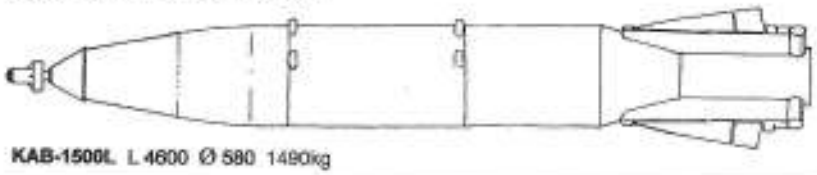
RBK-500-PTAB-2,5M L 2500 Ø 450 504kg

RKB-AO-2,5RT L 3700 Ø 450 525kg



KAB-500LK L 3050 Ø400 485kg

LASER GUIDED



KAB-1500L L 4600 Ø 580 1490kg

The NASR designations are Russian general-purpose HE bombs with Iraqi markings; the remainder are special-purpose Russian bombs (Lyn Haywood)

0529646

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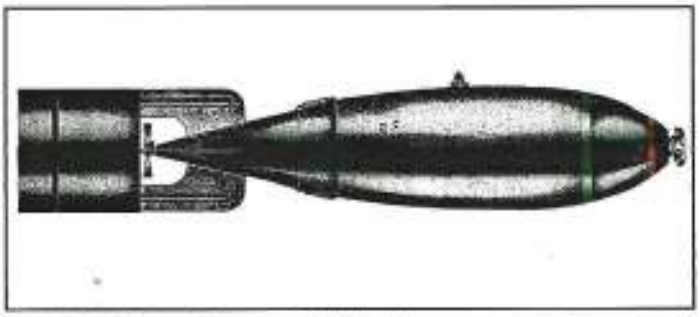
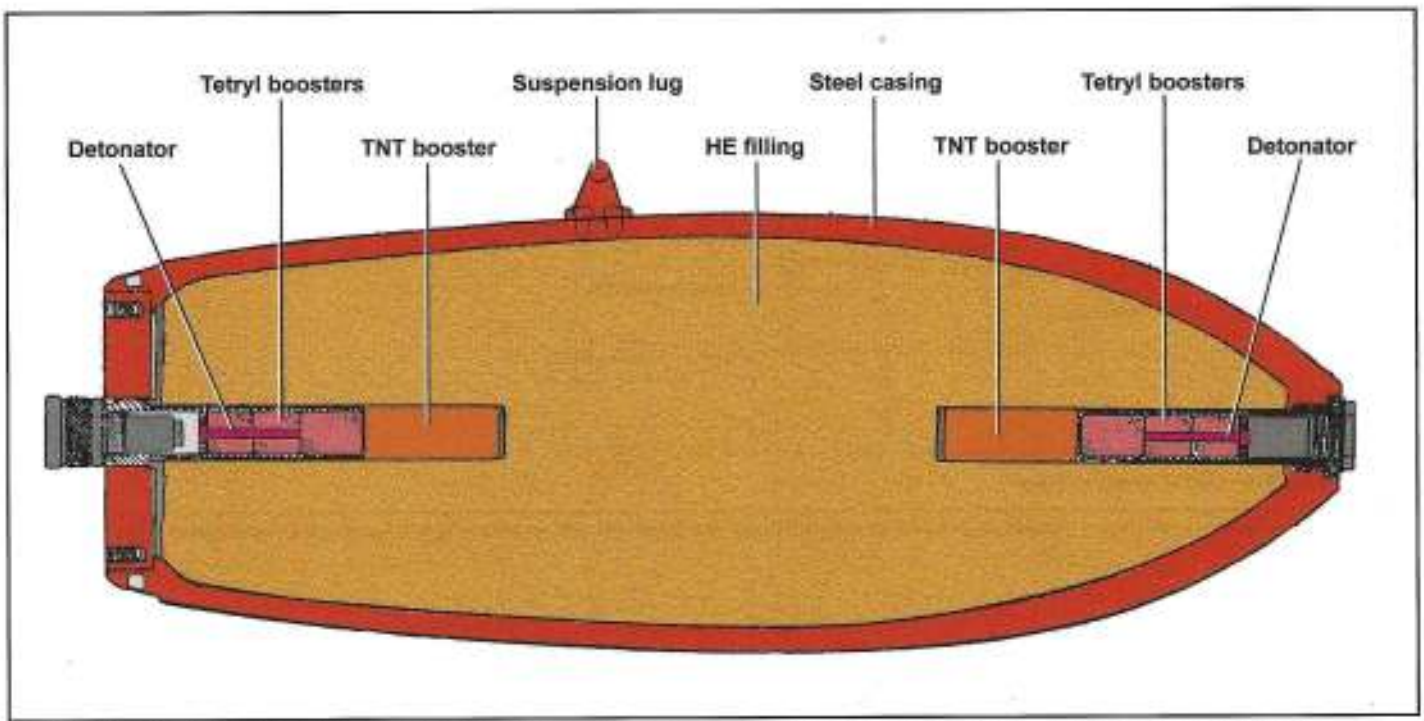
A British HC (High Capacity) 2,000 lb bomb. Note the three fuze wells (Colin King) 1374584

Markings on obsolete British HE bombs. The two at the front have red and white bands to denote a semi-armour piercing role. The bomb at the back has a red nose band and a green band on the forward part of the body to denote high capacity (Colin King) 0074653

Typical British Second World War 'cone and drum' type bomb tails, with integral arming vanes for tail fuzes (Colin King) 1374582



A British GP (General Purpose) 500 lb bomb 1374585



Section through a British GP (General Purpose) 500 lb bomb body. The nose and tail wells have explosive trains in place, for use with 'pistols' (Colin King) 1374611

SECOND WORLD WAR BRITISH BOMBS

General

British bombs used in the Second World War were generally designated by role (normally abbreviated), weight (in Pounds) and series (Mk 1 and so on). For example, the GP 250 lb Mk V is a variant of the General Purpose 250 lb bomb.

The following markings were used on British bombs before the introduction of the standard NATO marking system in 1964. Unless otherwise stated, the background (non-significant) colour was dark green. Where more than one colour band is listed, they have been placed in order working from the nose of the bomb towards the tail. Other markings originally stencilled onto bombs included weight, type, filling, filling factory and lot number.

Abbreviation	Role	Markings
AP	Anti Personnel	Dark green background, light green nose with red/white/red bands on nose
AS	Anti Submarine	Dark green background, red nose band, light green band at base of ogive
AT	Anti Tank	
DC	Depth Charge	
DP	Deep Penetration	Dark green background, red nose band
F	Fragmentation	Dark green background, red and light green nose bands
GP	General Purpose	Dark green background, red nose band, light green body band
HC	High Capacity	Dark green background, red nose band, light green band on forward section of body
IB	Incendiary Bomb	Dull red all over, or red nose. Small bombs: black/red/black bands on nose. Large bombs; red bands on fore and aft sections of the body
IT	Infantry Training	Dark green background, red and green nose bands
LC	Chemical	Grey background with band to indicate agent: black for tear gas; green for lung irritant; yellow for vesicant
MC	Medium Capacity	Dark green background, red nose band, light green band at base of ogive
SAP	Semi Armour Piercing	Dark green background, red and white bands on nose
TI	Target Identification	Black background with red band at base of ogive. Band around nose plug indicates colour of marker flares. A red cross on the body indicates explosive markers.
–	Smoke	Dark green background, red band around nose or aft section of body
–	Practice	White background, two green bands around tail cone

Most British Second World War HE bombs were a streamlined tear-drop shape, although high-capacity bombs were basically cylindrical. Most AP, SAP, GP and MC steel bomb bodies were made in one piece, with tails made from sheet steel. Tails generally consisted of a hollow cylindrical drum attached to a conical section, or to fins. Many tail units also incorporated arming vanes (see *Fuzes*, below). Tail units on most bombs up to 1,000 lb were attached with a spring clip assembly while tails on larger bombs were bolted on. Tails were normally marked with the type and size of bomb on which they were used; since the tails normally detached on impact and remained near the surface, they can be a useful aid to identification. Most bombs had a single suspension lug, although some were fitted with dual lugs for use on American aircraft.

Fuzes

British Second World War bombs used two distinct forms of initiation; 'pistols' and fuzes. *Pistols*, used mainly with HE bombs, were initiation mechanisms containing no explosive; these required a separate explosive train, consisting of a detonator and boosters, within the bomb. *Fuzes*, generally used with non-HE bombs such as smoke and marker flares, incorporated both an initiation mechanism and an explosive train. Most HE bombs were equipped with both nose and tail fuze wells; nose fuzes were normally used for immediate impact initiation and tail fuzes for delay actions, although sometimes both were used. Most fuzes used a safety clip, pin or fork, with tail fuzes generally incorporating arming vanes. Tail pistols tended to use an arming fork, which engaged with a similar fork attached to arming vanes built into the tail assembly. Both percussion and stab-sensitive detonators were used with pistols; the former using a blunt striker and the latter a needle-nosed striker.

Explosives

High Explosive fillings varied considerably, but were generally TNT for SAP bombs, with Amatol (TNT and Ammonium Nitrate) for GP, HC and MC bombs. For AP bombs, a less sensitive explosive known as 'Shellite' was generally used. This was a mixture of Lyddite (picric acid) and dinitrophenol.

Warning

Colour codes should never be relied upon in isolation, particularly where the meaning is dependent on the exact location of a coloured band as the same colour is often used to signify different roles. With these older bombs, other indicators of function should be considered in conjunction with any visible colour codes; these include shape, size, casing material and thickness, and location of fuzes.

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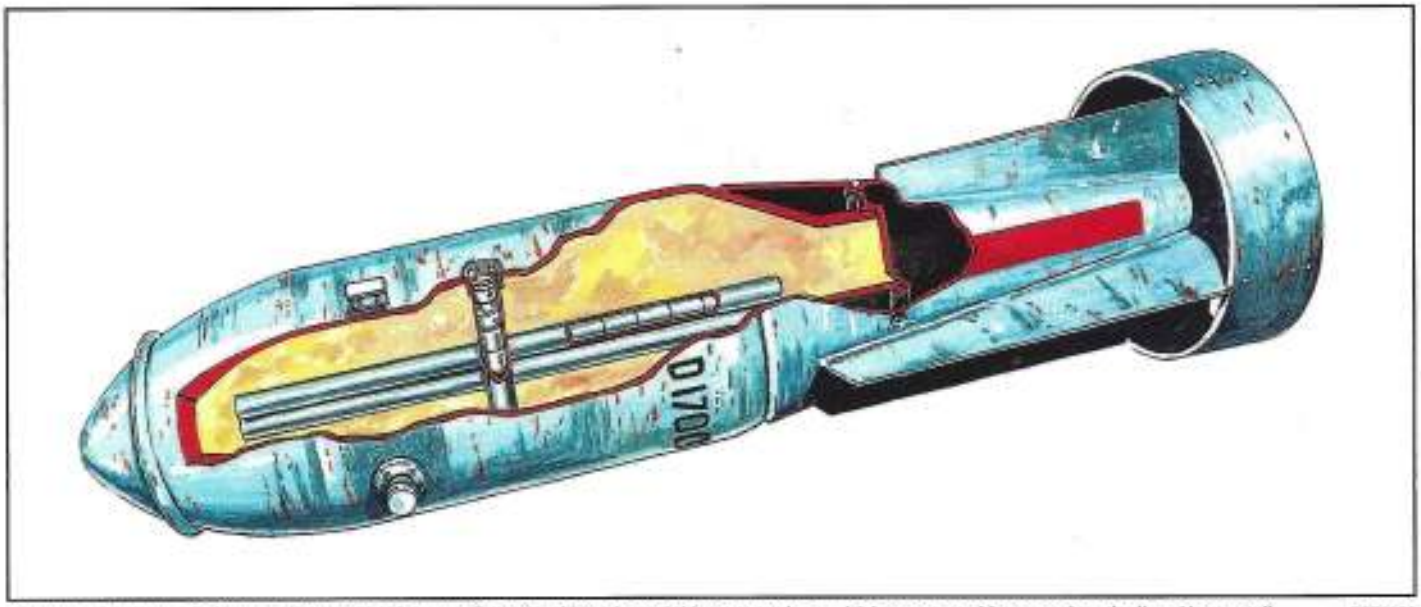

Cutaway diagram of a Second World War German SD 1700. Note the axial booster tubes, which were used in many bombs (Lyn Haywood) 0074169

A German SC 1,000 bomb body, which was nicknamed 'Hermann' (Colin King) 1041017

A Second World War German 500 kg SC bomb being recovered in Bosnia. Note the two fuze pockets (Bob Gravett) 1121170

German Second World War bomb tails. On the left is the common sheet steel type; to the right is a cast magnesium tail (Colin King) 1374583

SECOND WORLD WAR GERMAN BOMBS

General

Most Second World War German bombs used cast or sheet steel casings with separate tail units. The tail sections were based around a cone and four fins, with the fins of larger bombs braced using struts or rings. Most were made from sheet steel, but cast magnesium alloy was also used. The bomb bodies were suspended by a variety of means, including conventional lugs, T-shaped and H-shaped rail sections and (in the case of some smaller bombs) eye-bolts in the nose for horizontal suspension. Fuzes were generally mounted transversely into the body rather than being fitted in the nose or tail; for more information about fuzing, see separate entry *Second World War German bomb fuzes*. Some bombs were fitted with a 'Kopfring', a band of steel around the nose of the bomb body to prevent excessive penetration of land targets or ricochet on striking water.

Bomb designations

The following list shows the designations used with the most common types of German Second World War era bombs.

Designation	German term	Function	Notes
SC	Spreng Cylindrische	General purpose (HE)	Thin parallel walls with comparatively heavy nose. Some have 2 fuze pockets May have yellow paint on tail. Approx 55% HE by weight
SB/SA	Spreng Bombe	High Capacity (HE)	Thin-walled and designed for maximum blast effect. Impact fuzed. Up to 80% HE by weight
SD	Spreng Dickenwand	Fragmentation/semi-armour piercing (HE)	Thick-walled casing usually forged in one-piece, parallel at the sides and slightly thicker at the nose. Impact fuzed, sometimes using a stand-off probe. May have red paint on tail. Approx 35% HE by weight
SD	Spreng Dickenwand	Small bomb or submunition (HE)	Thick-walled, fragmentation bombs. Often mechanically fuzed and carried in containers
SBe	Splitter Beton	Concrete fragmentation (HE)	Made from concrete reinforced with steel. Thick-walled. Approx 20% HE by weight
PC	Panzerdurschlag Cylindrische	Armour-piercing (HE)	Often streamlined with thick cast steel walls and a heavy hardened nose section. Normally short delay fuzed. May have dark blue paint on tail
PD	Panzer Dickenwand	Armour-piercing (HE)	Thick, streamline casing; a heavier duty version of the PC. Less than 20% HE by weight
SP	Splitter	Fragmentation anti-personnel (HE)	
ZC	Zement Cylindrische	Cement (HE)	
BLC	Blitz Licht	Photoflash	
KC	Kampfstoff	Chemical	
NC	Nebel Cylindrische	Smoke	

Explosives

High Explosive fillings were generally TNT, Amatol (TNT and Ammonium Nitrate), or Trialen (RDX, TNT and aluminium). Additional booster tubes (generally containing TNT, Tetryl or RDX/aluminium/wax) were sometimes placed along the central axis of the bomb, adjacent to the fuze pocket (as shown in the cutaway diagram).

Notes

Bombs intended for internal carriage were generally painted dark green, while those carried on external racks were light blue.

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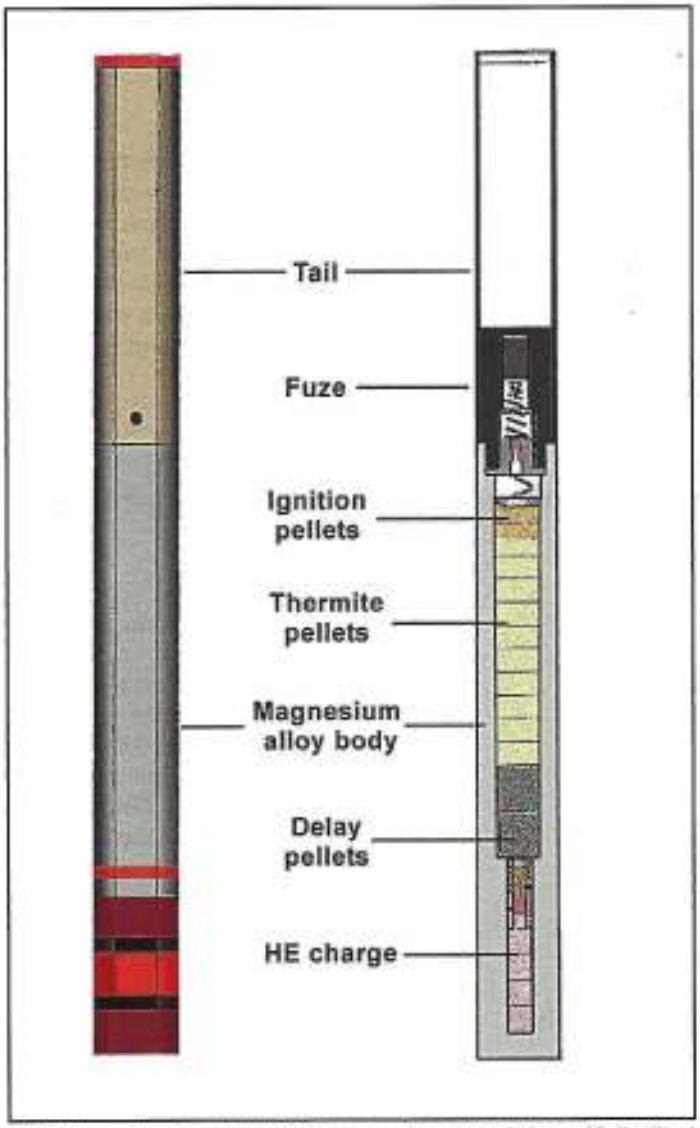
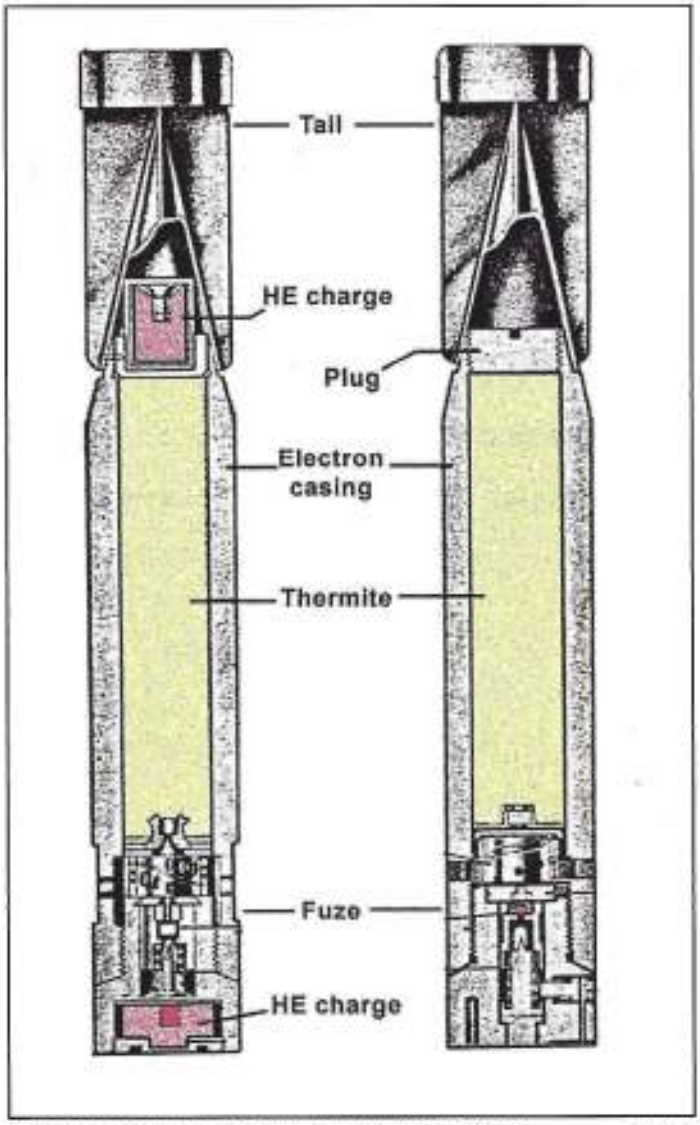


British incendiary bomb 4 lb 'X' incorporating a Tetryl charge (Colin King)
1041019



Variations of German B1E incendiary bombs (Colin King) 1041020

Second World War incendiary bombs. Those with round bodies are German, the hexagonal bomb is British
(Colin King, courtesy of DEODS)
0546810

SECOND WORLD WAR INCENDIARY BOMBS

Description

Small incendiary bombs were widely used during the Second World War, many being in the form of submunitions weighing 1 or 2 kg, with 2 in (50 mm) diameter bodies. German, British and US versions were broadly similar in appearance, having long thin metallic bodies with round or hexagonal cross section and small tail fins. In most types, the casing itself was made from a combustible magnesium alloy known as 'Electron', with a hollow core containing a thermite composition. Some incendiaries incorporated small HE charges to deter local people and fire fighters, who would often move burning incendiaries away from buildings or drop them in water. In British incendiaries (which were tail fuzed) a Tetryl charge was added in the nose, or a small amount of the thermite filling was replaced by black powder. British incendiaries with gunpowder charges were marked with a letter 'E'; those containing Tetryl were marked with an 'X'. In German incendiaries (which were nose-fuzed) PETN charges were sometimes incorporated into the nose or tail, while some used additional TNT charges screwed onto the nose.

Operational details

Typical operation

The incendiary was armed by extraction of a safety rod during release from the container. On impact, a simple striker mechanism was designed to overcome a creep spring to initiate the thermite filling, although many failed to function when their fall was broken by vegetation or soft ground. After a few seconds, the burning thermite would also ignite the magnesium alloy body to create intense heat (around 1,300°C). The temperature alone was often sufficient to initiate the explosive charges, which typically exploded between 1 and 4 minutes after ignition. However, bombs with HE charges in the nose incorporated pyrotechnic delays to ensure detonation.

Specifications

Nationality	British	German	German
Designation:	I.B. 4 lb	B1EZB	B2.2EZ
Diameter:	42 mm (across flats)	51 mm	51 mm
Overall length:	544 mm	344 mm	527 mm
Weight:	1.8 kg	1 kg	2.2 kg
HE type:	Tetryl	PETN	TNT
HE location:	Nose	Nose and tail	Nose (add-on)

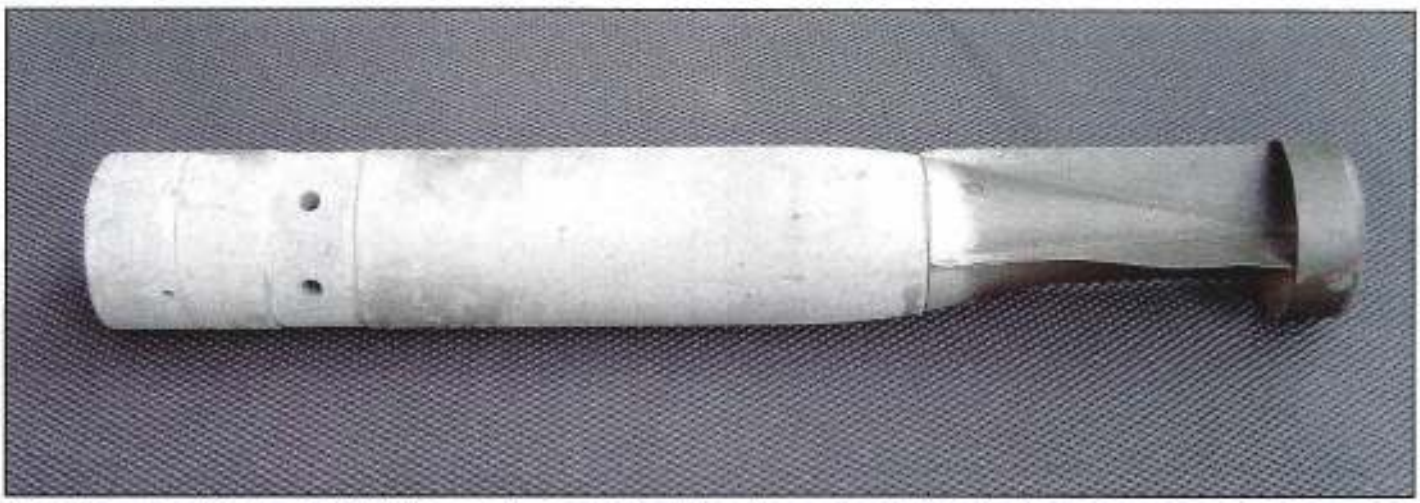
Larger incendiary bombs

Larger incendiary bombs were also produced by Britain and Germany during the Second World war. British bombs ranged from 30 to 500 lbs, and tended to use liquid fillings based on petrol, sometimes with phosphorus igniters. Of particular note is the 500 lb Mk I, which contained 16 gallons of liquid phosphorus with a gunpowder burster.

Larger German incendiary bombs, ranging from 50 to 250 kg, used a variety of liquid, solid and gel fillings, including phosphorus, thermite in electron casings, oil and petrol-based mixtures and magnesium/charcoal mixtures. In some bombs, phosphorus was contained in glass bottles within the bomb casing.

Notes

Phosphorus-based mixtures ignite spontaneously in contact with the air. See also *Incendiary bombs* in this section.



A 1 kg German incendiary bomb, with 2 inch diameter body made from 'Electron' magnesium alloy (Colin King) 0573261

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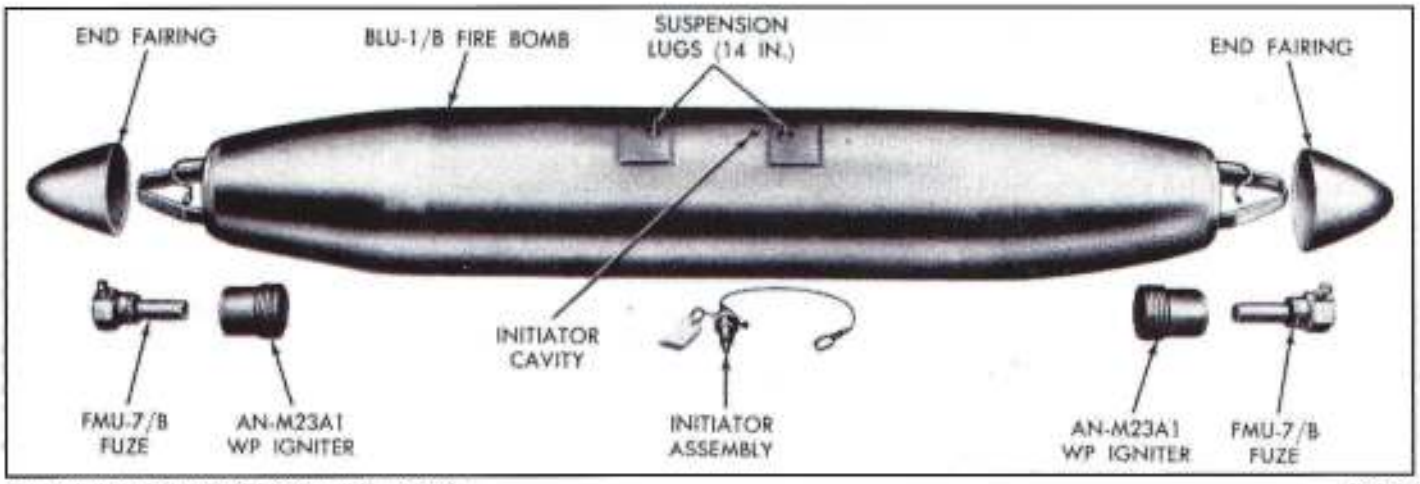
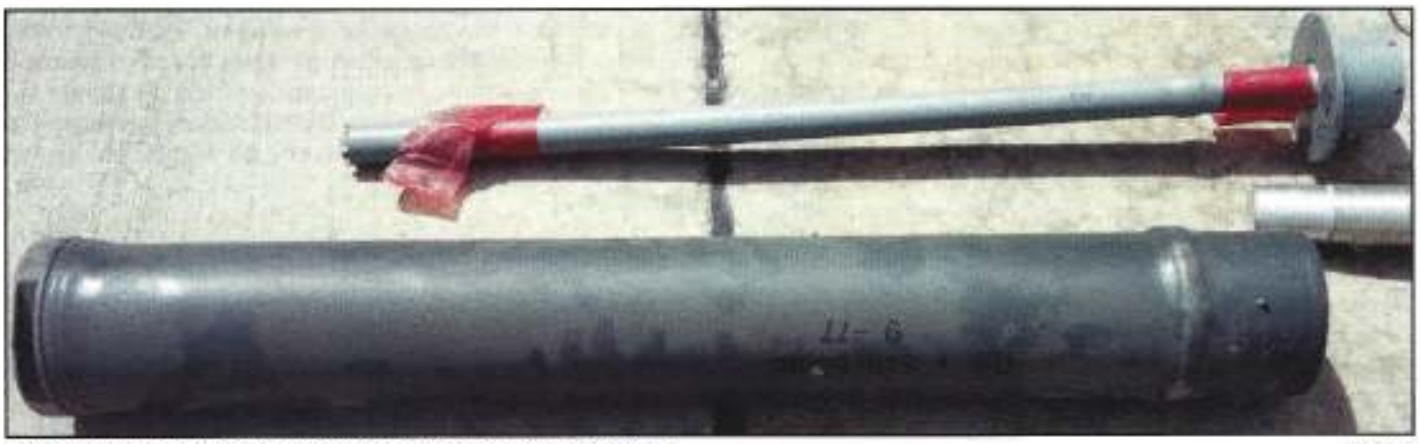


Components of the US BLU-1/B incendiary bomb 0573256

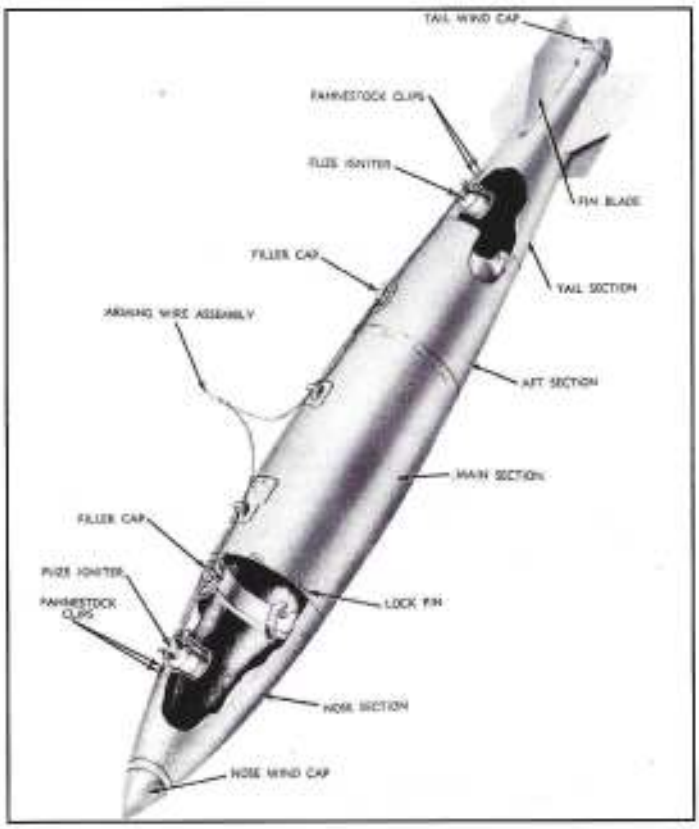


The central burster tube and WP igniter from the ZAB-500Sh (Colin King) 0573260

The body of the Russian ZAB-500Sh, showing the fuze and umbilical cable (Colin King) 0573258

The fuze assembly of the ZAB-500Sh (Colin King) 0573259

The initiator from a US incendiary bomb, consisting of an M173 all-ways acting fuze in an AN-M173A1 igniter filled with White Phosphorus (Colin King) 1341062



Components of the US MK79 Mod 1 incendiary bomb 0573257

INCENDIARY BOMBS

Description

Many of the older (post Second World War) incendiary bombs, including those produced in Brazil, Chile, China, Spain and the former Yugoslavia, are based on obsolete US designs, such as those shown in the diagrams. These are generally simple sheet-metal tanks filled with Napalm, a petroleum-based liquid, thickened with Napthalene and oil to decrease volatility and increase adhesion. Most use two fuze assemblies, each of which incorporates a small HE burster charge and an ignition charge (normally containing White Phosphorus (WP)). Impact fuzes are often mounted in the side of the bomb casing, and fitted with wind-driven arming vanes or cups. Many of the early designs had no tail fins or other form of stabilisation, and are easily confused with aircraft drop tanks (auxiliary under-wing fuel tanks).

Russian designs, also used by Iraq and former Warsaw Pact countries, tend to be fin-stabilised and are therefore more conventional in appearance; both high-drag and low-drag shapes are in service. The Russian ZAB series are significantly different from the US designs and use a full-length HE central burster and igniter.

Operational details

Typical operation

The unstabilised US incendiary bombs, which tumble when dropped, rely on mechanical 'all-ways acting' fuzes, such as FMU-7/B, designed to function regardless of the impact angle. A typical all-ways acting fuze uses a striker mounted opposite a stab-sensitive detonator in a telescopic steel assembly, separated by a creep spring. Once released by the arming mechanism, the assembly is free to move within a cavity with tapered ends. Axial impact in either direction forces the striker into the detonator, or vice versa, while side impact results in the assembly being compressed by the tapered ends of the cavity. On initiation, the small HE charge bursts the surrounding WP capsule and outer casing (although this is normally ruptured on impact); the WP ignites spontaneously on exposure to air, also igniting the napalm filling. When dropped at low level, the forward motion of the bomb disperses the burning napalm in a cigar-shaped pattern across the target area.

The nose fuze of the Russian ZAB-500 is electrically armed via an umbilical cable before release from the aircraft. On functioning, the fuze detonates an HE burster charge in a narrow steel tube that runs the full length of the bomb. The burster runs through the centre of a larger tube containing WP, and shatters both the WP container and the outer bomb casing when it detonates. Impact fuzes, often mounted on the side of the bomb casing, have been augmented or replaced by nose-mounted proximity fuzes.

EOD considerations

- Non-stabilised incendiary bombs use all-ways acting fuzes
- All-ways acting fuzes are liable to be initiated by movement or impact
- Most incendiary bombs contain HE bursters and many contain WP igniters
- If damaged, WP igniters may ignite spontaneously in contact with air
- Old liquid-filled incendiary bombs are easily confused with drop tanks
- Many liquid-filled incendiary bombs are thin-walled and therefore liable to rupture
- Ruptured bombs may leak liquid fuel, which will run downhill
- Protective clothing and breathing apparatus may be needed
- Leak sealing and packaging measures may be required
- Demolition is likely to create a large fireball and may ignite surrounding vegetation.

Example	Russian ZAB-250	US BLU-1/B	US MK79 Mod 1
Diameter:	325 mm	470 mm	498 mm
Length:	1.51 m	3.3 m	4.266 m
Weight:	250 kg	397 kg	443 kg
Filling:	n/k	Napalm	Napalm

Fillings

A variety of fillings have been used in incendiary bombs. Liquid fillings tend to be based on petrol or oil, but liquid phosphorus is also used. Mixtures are often thickened with substances such as rubber, and may incorporate either solid or liquid phosphorus to cause ignition on contact with air. Liquids may also be absorbed onto a combustible material, such as cotton waste. Solids include thermite, magnesium/charcoal and a variety of pyrotechnic mixtures. Fillings may be used in bulk, or divided within a number of smaller submunitions; in this case, the submunition may also have a combustible casing, formed of a magnesium alloy such as 'electron', for example.

Notes

Diagrams showing some Russian special-purpose bombs are included in the *Russian Federation Bombs* entry; see also *Second World War incendiary bombs* and entries on national production of *Other types of bomb*, which includes basic specifications and some photographs. See also separate entry on *All-ways acting fuzes* for more details of the M173 fuze.

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An empty US CBU-55/B casing. This bomb dispenses three BLU-73/B FAE bomblets, each containing 33 kg of ethylene oxide (Colin King) 0074261

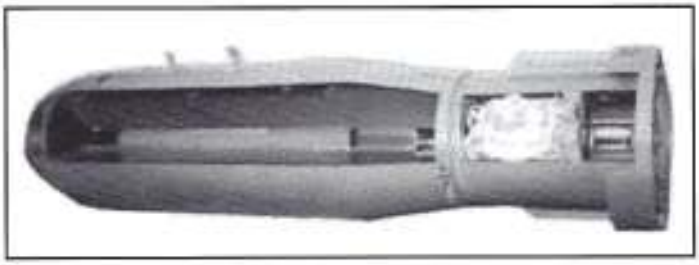
A US B83 nuclear bomb and components (US DoE) 0051965

A first generation fuel-air explosive bomb in Iraq, which appears to be based on a Spanish design. Note the angled holes in the tail for dispensing the cloud detonators (Colin King) 1289963

The US Mk 94 was a 500 lb bomb filled with GB chemical agent (Colin King) 1041018

The US Focused Lethality Munition (FLM) is an example of a Low Collateral Damage Bomb (LCDB) (USAF) 1185978

A sectioned ODAB-500PM FAE bomb. Note the central HE burster, which (in the live bomb) is surrounded by smaller burster tubes. A large HE cloud detonator is located in the tail, behind the parachute (SRPE Bazalt) 0006383



OTHER BOMB TYPES

Description

In addition to HE, cluster and incendiary bombs, which are detailed in separate entries, there are several other possible bomb fillings including chemical agent, flare or flash composition flechettes, leaflets, smoke, and inert fillings (such as sand or concrete) used in practice bombs. Of these, the two categories of particular significance to the EOD technician are chemical and Fuel-Air Explosive (FAE), since both are capable of substantial destruction if they function and either may contain one or more HE charges. Dispensers with fillings such as illuminants, marking flares and smoke compositions are not particularly hazardous and are therefore unlikely to be given priority for EOD action. Nuclear bombs are extremely complex, and the exact details of their composition are classified; their disposal would require training, procedures and equipment unavailable to the EOD technician in the field.

Many of the less hazardous bomb types have a conventional appearance and some share casings with HE or cluster munitions. This makes identification more difficult and increases the need to rely on markings. Even without the presence of HE, these bombs may incorporate a number of hazards, including ejection or marking charges, pyrotechnic igniters and spring-loaded fin assemblies.

A recent innovation is the development of the 'Low Collateral Damage Bomb' (LCDB), which aims to minimise unpredictable effects of long range fragmentation.

Operational details

Typical operation

Chemical bombs

Virtually any bomb configuration could be adapted to deliver chemical agents; however, both Russia and the US developed purpose-built bombs and submunitions. These are mostly thin-walled carriers filled with liquid agent and fitted with impact fuzes and burster charges. In the case of bombs like the US 500 lb Mk 94 and 750 lb MC-1, the central burster tube extends the whole length of the bomb and contains around 7 kg of HE. One unusual design is the US BLU-80 'Bigeye', which is a binary weapon in which the agent is formed by the mixing of two constituent compounds during deployment. Some Russian chemical bombs (or copies) may still be in the inventories of former Warsaw Pact countries or Soviet-equipped states. Although banned by the Chemical Weapon Convention (CWC) of 1993, signatories are still destroying stockpiles; elimination is due to be complete by 2012, but may take longer. Several nations believed to possess chemical weapons have not signed or ratified the CWC. See the *Chemical weapons* entries for additional information.

Fuel-Air Explosive (FAE) bombs

Weight for weight, FAE can generate about three times as much energy as conventional high explosive. It also produces a far longer pressure pulse, which can have a much greater destructive effect on people and structures. Although its military utility has been recognised for some time, most countries have failed to produce reliable FAE weapons until recently. Unlike some smaller FAE weapons (which can detonate in a single event), the initiation of most FAE bombs occurs in two distinct events. The first is the use of an HE burster charge to open the casing and form a cloud of fuel in the atmosphere; the second is the initiation of the resultant fuel-air mixture using one or more HE 'cloud detonators'. The need for two separate explosive events means that FAE bombs incorporate complex fuzing systems and components. The most common fuels are Ethylene Oxide, Propylene Oxide and Isopropyl Nitrate (IPN). The terms 'volumetric' and 'thermobaric' are sometimes used to describe subtle differences between FAE-type weapons, with some Russian literature also describing them as 'vacuum bombs'. Newer thermobaric bombs, such as the US BLU-118/B, are believed to use advanced fillings that allow detonation in a single event. One such composition is known as 'Solid Fuel-Air Explosive' (SFAE).

Low Collateral Damage Bombs (LCDB)

The simplest LCDBs either reduce the HE charge, or replace the normal steel casing with a lightweight material, such as a composite; this shreds on detonation, with the resulting pieces decelerating rapidly to minimise the fragmentation range. The US GBU-126/B, for example, is basically a Mk 82 GP bomb containing less than 15% of the original HE content. A further refinement is the incorporation of a heavy metallic powder, such as tungsten, into the explosive to produce 'Dense Inert Metal Explosive' (DIME). A typical mixture might contain 25% HE and 75% tungsten by weight, although the volume of the original HE is increased only slightly. The result is a dense explosive with a devastating near-field impulse (from a huge number of high velocity powder 'fragments'), yet no long range fragmentation. DIME has been incorporated an LCDB known as the 'Focused Lethaity Munition (FLM), and may have further application in penetration bombs.

EOD considerations

Chemical, and FAE bombs can contain large HE burster charges; these bombs are mostly thin-walled and therefore liable to rupture; ruptured bombs may leak liquid fuel or chemical agent, which will run downhill; protective clothing and breathing apparatus may be needed; leak sealing and packaging measures may be required; identification of fill is vital before EOD action; downwind hazard areas should be calculated for chemical agents.

Type	Chemical	Fuel-Air Explosive	LCDB
Example:	Russian KhAB-500 R-5	Russian ODAB-500 PM	US GBU-126/B
Diameter:	450 mm	500 mm	273 mm
Length:	2.4 m	2.28 m	2.21 m
Weight:	300 kg	520 kg	241 kg
Filling:	175 kg chemical agent	193 kg fuel	12.3 kg HE

Notes

Diagrams showing some Russian special-purpose bombs are included in the *Russian Federation Bombs* entry; see also entries on national production of *Other types of bomb* in separate sections, which include basic specifications and some photographs.

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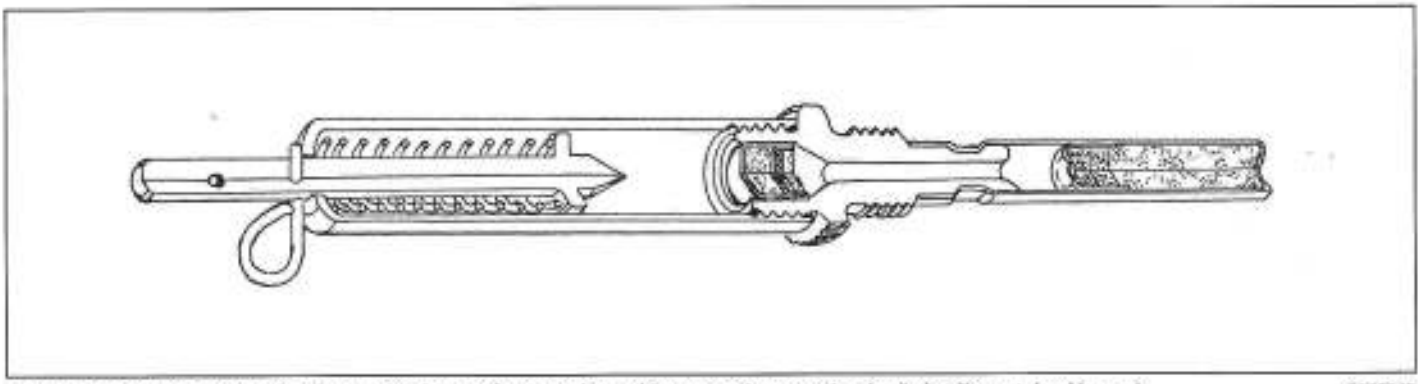
Obsolete British booby traps are still found, or copied, in several parts of the world. From left to right: No 5 Mk 1 (pressure), No 3 Mk 1 (release/anti-lift), No 4 Mk 1 (pull) (Colin King) 0074693



The Russian MUV. In its simplest form, a booby trap fuze may be nothing more than a spring-loaded striker retained by a pin 0005247

Mine tripwire fuzes can also be used in pull-actuated booby traps. From the top: Yugoslav UPMR-2A, Czech RO-1, Russian MUV-2 (Colin King) 0074694

The Yugoslav UDOd-1 is a simple device, initiated by the action of unscrewing the top section from the body. This could be used in applications such as the booby trapping of vehicle fuel caps (Colin King) 0021266

BOOBY TRAPS

MECHANICAL BOOBY TRAPS

Description

Booby traps are, by definition, victim-actuated devices that generally rely on concealment or deception to achieve their aim. The main operating principles of mechanical booby traps are pressure, pull (either axial or radial) and pressure release (anti-lift); pull actuation is normally achieved using a tripwire or a short line fixed to an object likely to be moved by a victim. These few actions can be used to booby-trap areas or objects in an almost limitless number of ways. Other types are intended for more specific applications, such as tension release (used with tripwires) and release by unscrewing (for booby-trapping vehicle fuel filler caps, bomb fuzes and so on). Most designs of mechanical booby trap are simple, cheap and reliable. They are also extremely versatile, their employment limited only by the experience and imagination of the setter.

Although some have been manufactured in plastic, the majority are made from metal and are therefore easily detectable. Many are based around a helical spring and use a tubular fuze body or stamped metal casing a few centimetres long. At one end is the means of actuation (prongs, pin, lever or plate), and at the other is the attachment for an initiator. Most modern devices are simply threaded to accept a standard percussion or stab-sensitive detonator assembly, though some older types use a 'fuze adaptor', which contains a percussion cap for the initiation of a pyrotechnic fuze. The use of safety pins is almost universal, with some multifunction fuzes having more than one to allow the selection of different options. Some devices have a small built-in explosive charge; these tend to be for sabotage use by special forces and are comparatively rare.

Photographs and diagrams of mechanical booby traps are contained in the following entries: *Pressure-actuated booby traps, Pull-actuated booby traps, Anti-lift booby traps* and *Combination booby traps*. See also separate entries on *Electrical and electronic booby traps* and *Delay devices*.

Operational details

Typical operation

Most mechanical booby traps rely on some form of steel spring as their power source for initiation. In most booby traps the spring is retained under compression or tension by the actuating mechanism until the device is initiated; this is known as a 'cocked striker'. Cocked strikers retain the potential energy for initiation at any time and are therefore inherently more dangerous than other mechanisms. In the simplest designs, a spring-loaded striker is held back by a retaining pin, as with the Russian MUV fuze. Some of the more advanced designs use a sear or retaining balls to permit smoother operation and lower actuation force. Some mechanical fuzes are ingeniously designed to release the same initiation mechanism in two or more ways; these are known as 'combination switches'. Combination switches reduce the need for a wide range of booby traps to suit different situations, though they are generally more complex and entail more training to avoid accidental initiation by the setter.

EOD considerations

- Disarming booby traps normally entails significant risk, and some mechanisms are particularly sensitive
- Booby traps may be attached to large charges, remote from the fuze location
- It is not normally advisable to initiate a booby trap deliberately; where possible, a proper demolition should be set up
- If a booby trap is to be deliberately initiated, its full extent must be known before any EOD action is taken
- Booby traps are normally 'pulled' remotely or are demolished in place; they are disarmed only if there is no alternative
- Once pulled or otherwise disturbed, an adequate 'soak time' should be applied before an approach is made
- Clearance procedures should be carefully reviewed in situations where booby trapping is suspected.

Typical specifications

Example	British No 4 Mk 1	US M1A1	Yugoslav UMOP-1
Operation:	Pull	Pressure	Pressure release
Diameter/width:	12 mm	38 mm	20 mm
Length:	70 mm	90 mm	76 mm
Operating force:	3 kg	9 kg	4–15 kg load required

Notes

Since booby traps are generally intended to detonate a secondary charge, they rarely contain much explosive. However, there is no limit to the size or type of charge that they may be used to initiate, and booby traps have often been used to detonate large shells, mortar bombs and even aircraft bombs. They may also initiate several charges or munitions simultaneously using detonating cord links. In addition to being effective in the denial of access, the devious nature of booby traps, together with their unpredictable effect, adds to the fear with which they are regarded. The presence or threat of booby traps can have a significant effect on morale, and unexplained accidents and explosions are often attributed to them.

For more detailed information about specific booby traps, see *Jane's Mines and Mine Clearance*.

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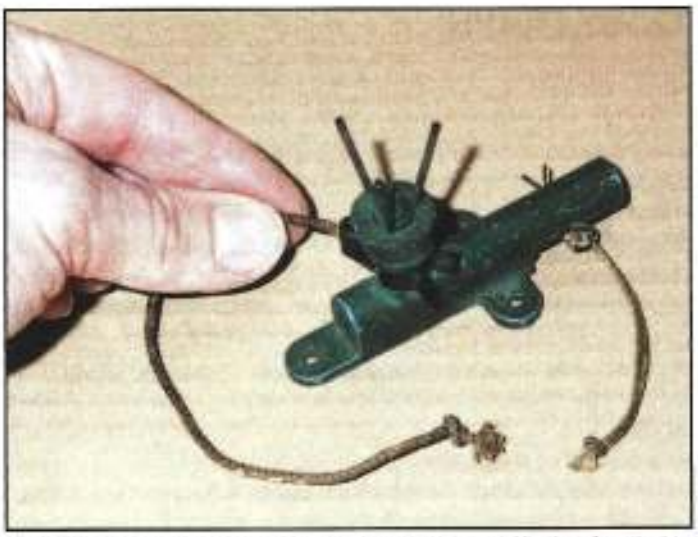
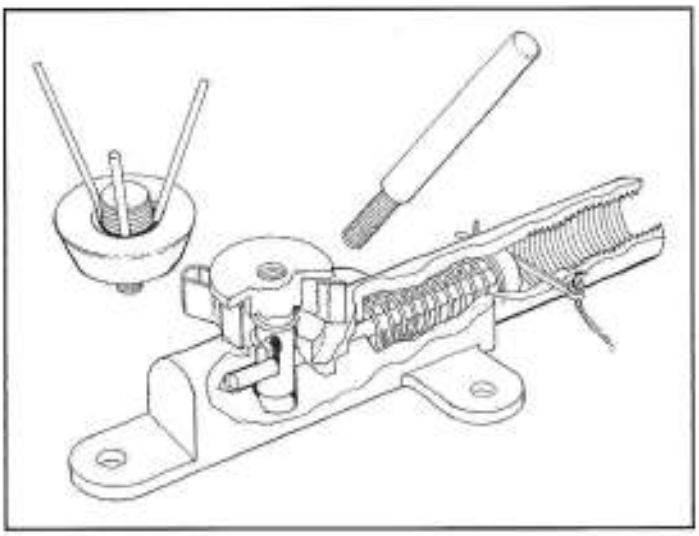
PRESSURE-ACTUATED BOOBY TRAPS

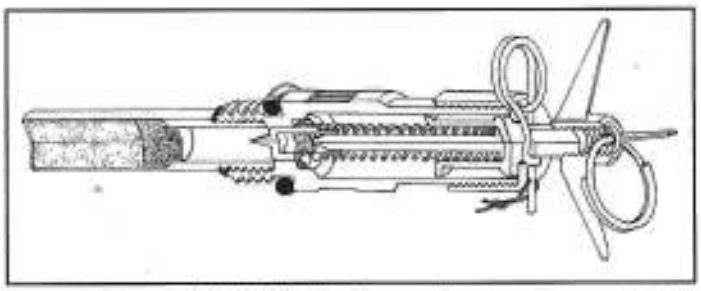


The US M1A1 pressure fuze with pronged extension and both safety devices in place. Operating load: 9 kg (Colin King) 0021224



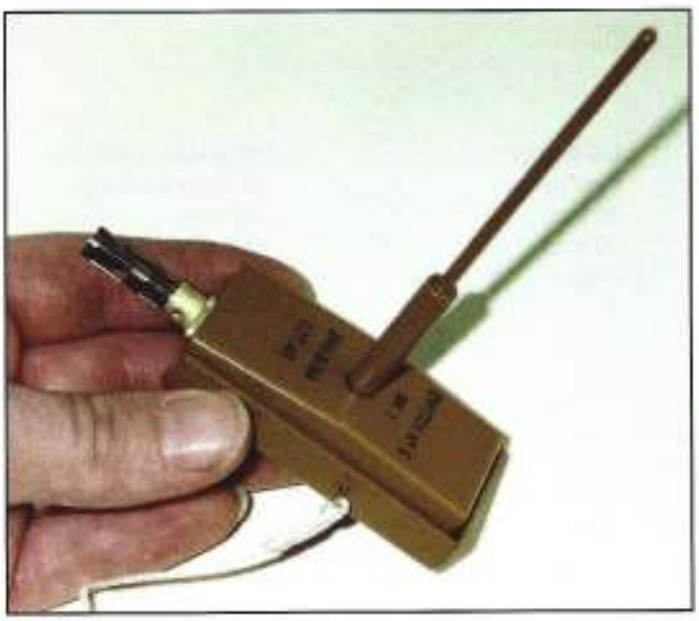
Cutaway diagram of the US M1A1 pressure fuze, shown with extension pieces (Lyn Haywood) 0001684

The Yugoslav UMNP-1 pressure fuze has an integral detonator and operates when the prongs are tilted. It can also be actuated using a tripwire attached to the ring on the central spigot. Operating load: 2–7 kg (Colin King) 0074096



Cutaway diagram of the UMNP-1 (Lyn Haywood) 0812658

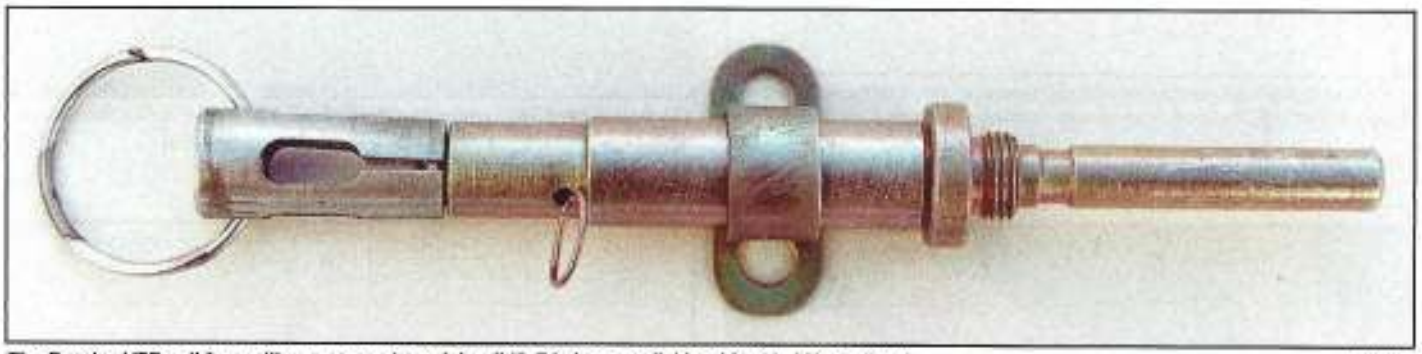
'Prank' is a South African pressure fuze that can be also be made to function on pressure-release. The 'Apex' detonator (to the right) has a hole through it to accept detonating cord (Colin King) 0074082



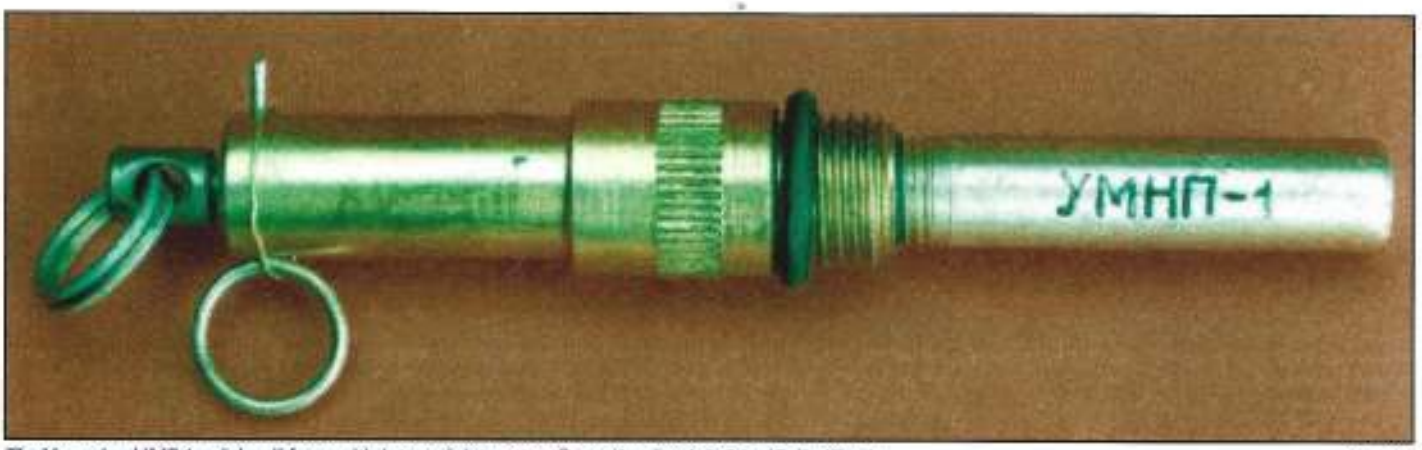
The British No 5 Mk 1 pressure fuze, with extension piece fitted; note the fuze adaptor on the left-hand end. Operating load: 10–20 kg
(Colin King)
0074091

PULL-ACTUATED BOOBY TRAPS

The Russian MUV, seen here fitted with an MD-5M detonator, is one of the most common pull fuzes (Colin King) 0074796



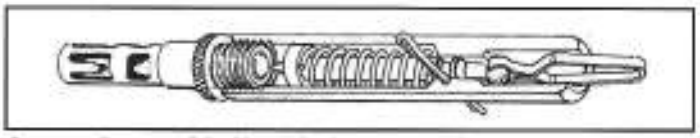
The Russian VPF pull fuze will operate under axial pull (3–7 kg) or a radial load (2–4 kg) (Colin King) 0021208



The Yugoslav UMP-1 axial pull fuze, with integral detonator. Operating load: 1–3 kg (Colin King) 0056100

The British No 4 Mk 1 pull fuze (Colin King) 0074089

The Yugoslav UMP-2 pull fuze has an integral detonator and is actuated by a radial pull of 2–6 kg (Colin King) 0074098



Cutaway diagram of the No 4 Mk 1 (Lyn Haywood) 0512655

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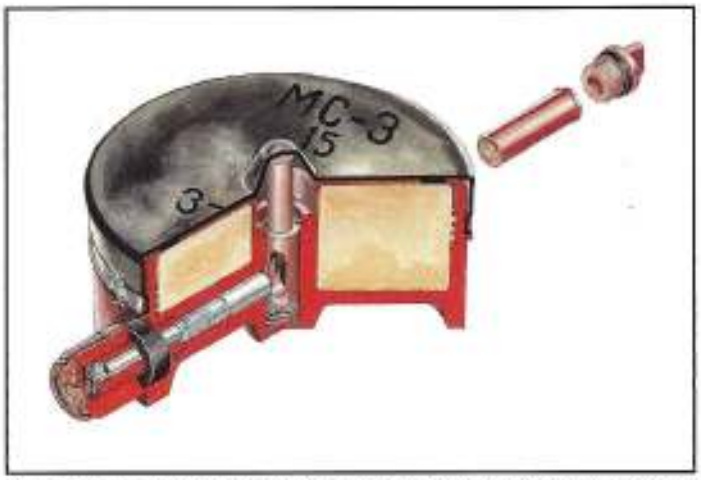
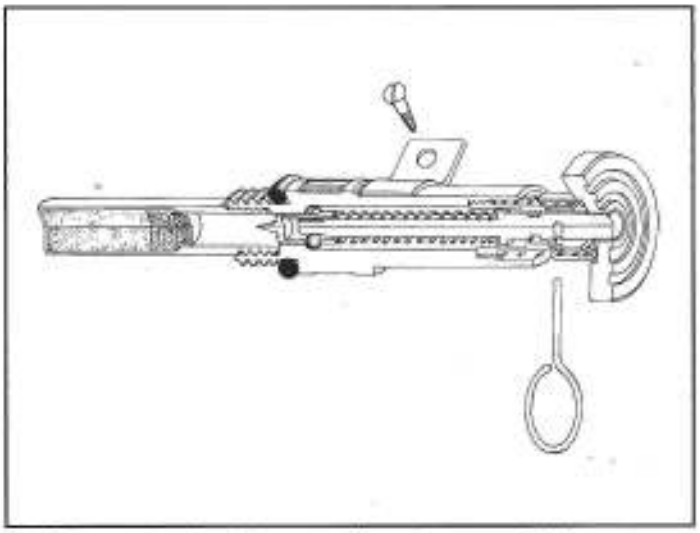
ANTI-LIFT BOOBY TRAPS



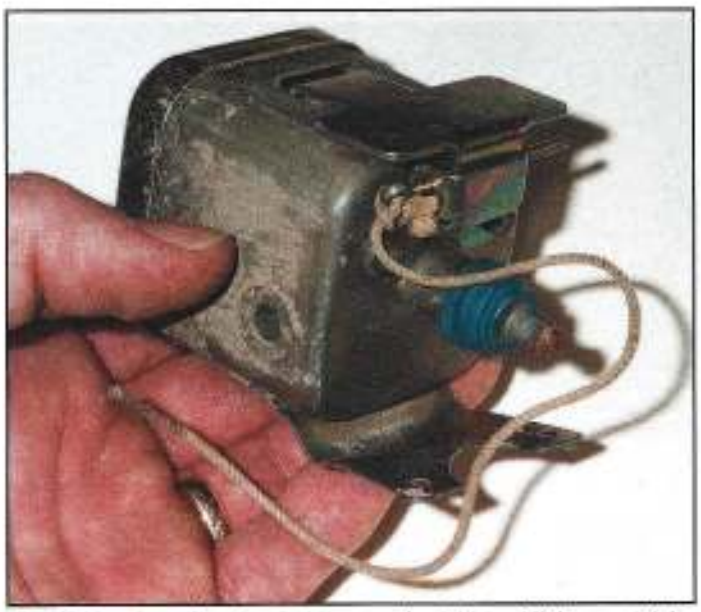
The Russian MS-3 is an anti-lift booby trap based on the PMN mine. It contains 310 g of TNT and requires a minimum retaining load of 5 kg (Colin King) 0021309

The British No 6 Mk 1 pressure-release fuze. A fuze adaptor screws into the right-hand end. Minimum retaining load: 3 kg (Colin King) 0021267

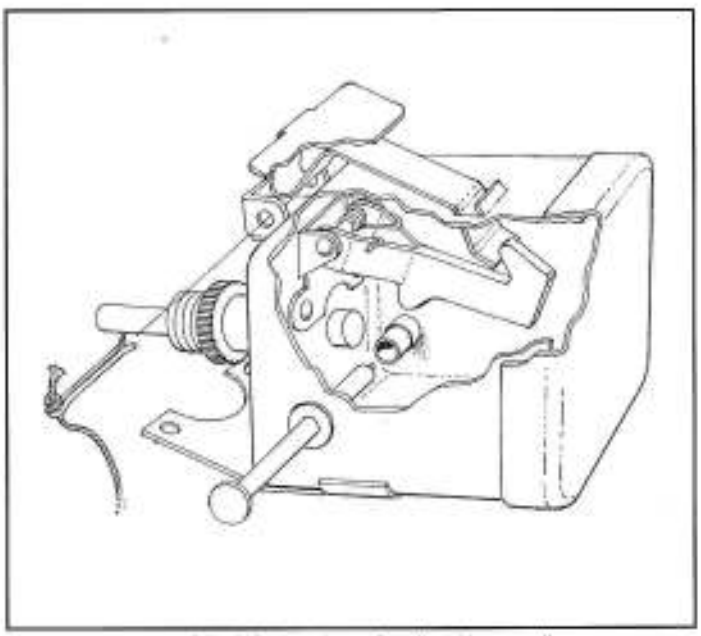
The Yugoslav UMOR-1 anti-lift booby trap with integral detonator. The pressure plate is retained by a load of 4–15 kg (Colin King) 0074097



UMOR-1 armed: as the pin is removed, a collar covers the holes to prevent neutralisation (Lyn Haywood) 0612659



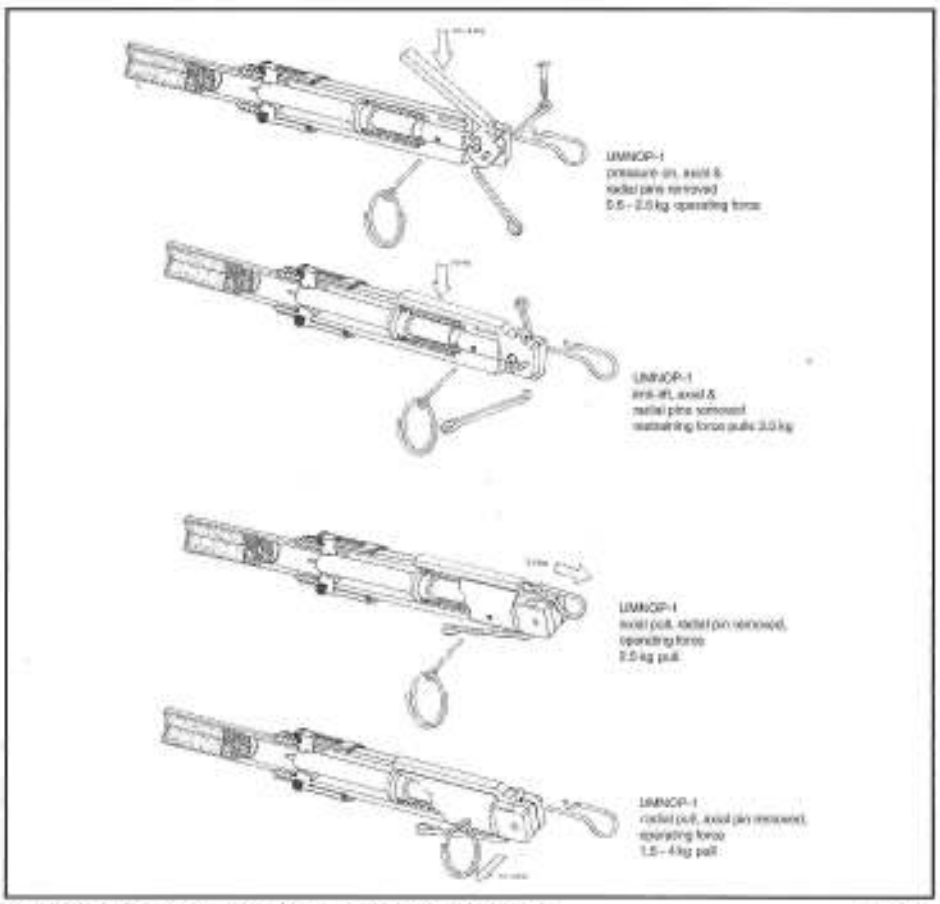
The US M1 release fuze, fitted with percussion initiator. Minimum retaining load: 1 kg (Colin King) 0021225



Cutaway diagram of the US M1 release fuze (Lyn Haywood) 0001665

COMBINATION BOOBY TRAPS

The Yugoslav UMNOP-1 combination fuze, with integral detonator (Colin King) 0021271



The four operating modes of the UMNOP-1 (Lyn Haywood) 0021505

The British L5A1 combination firing device can be actuated by pressure or pull (3 kg), release of pressure (with a load of 1–20 kg) or tripwire tension-release (Colin King) 0074692

The Russian ML-7 has a delay fuze similar to that in the PFM-1 mine, but can also be made to function on pull or pressure-release (Colin King) 0573262

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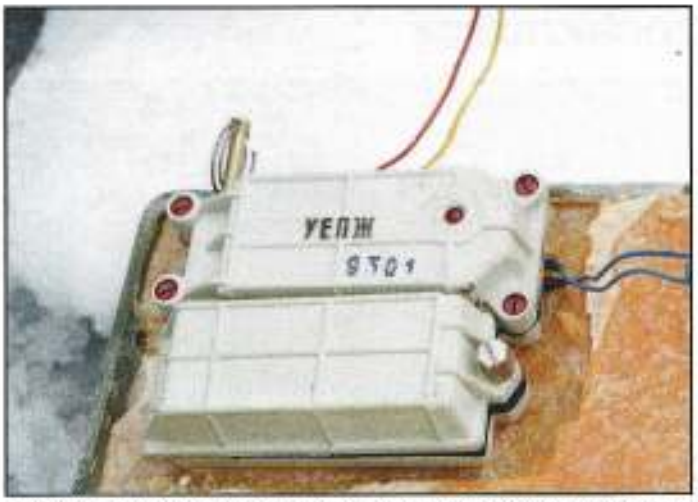
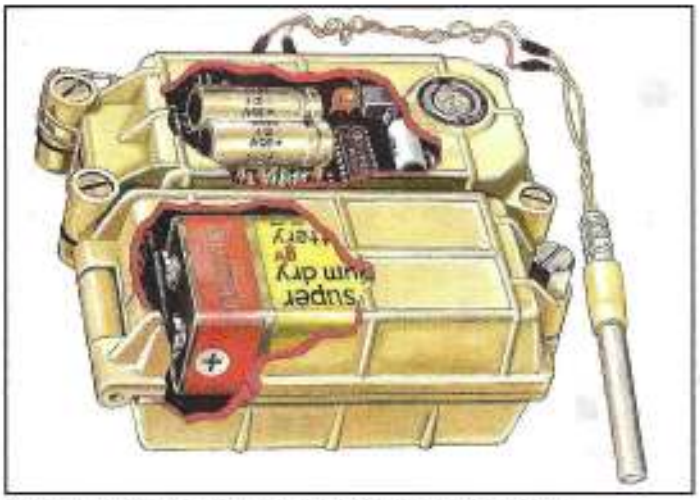
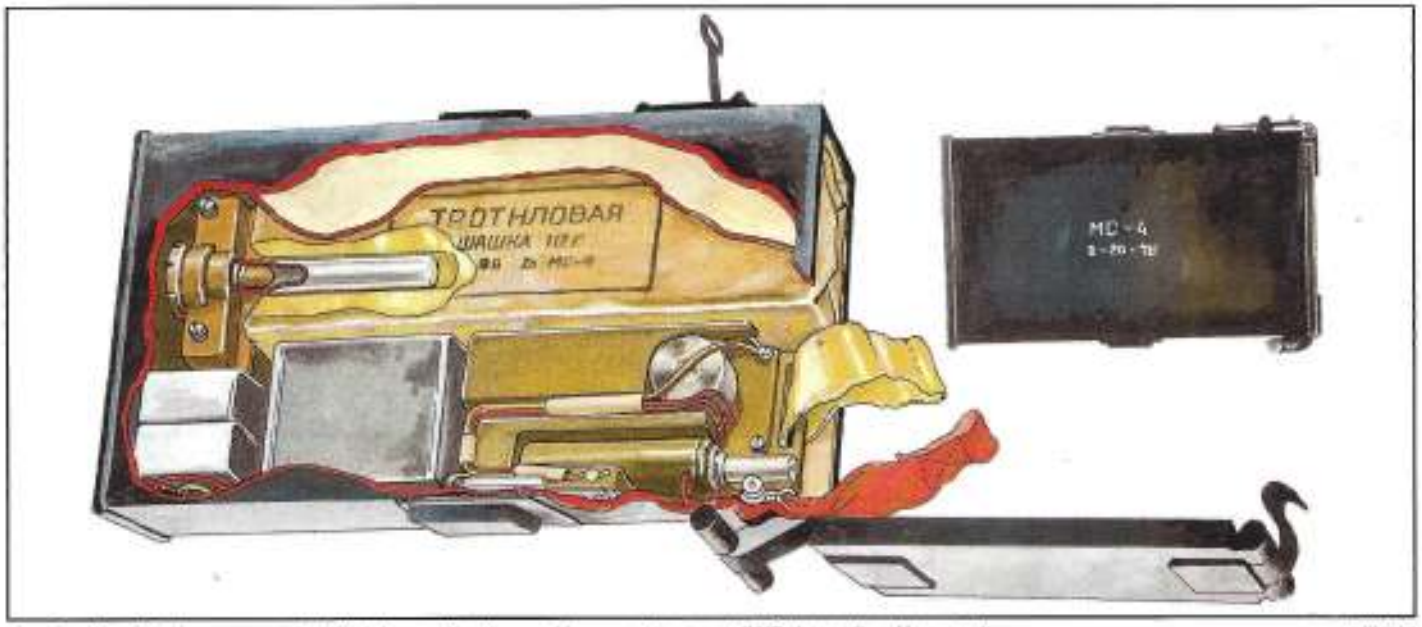


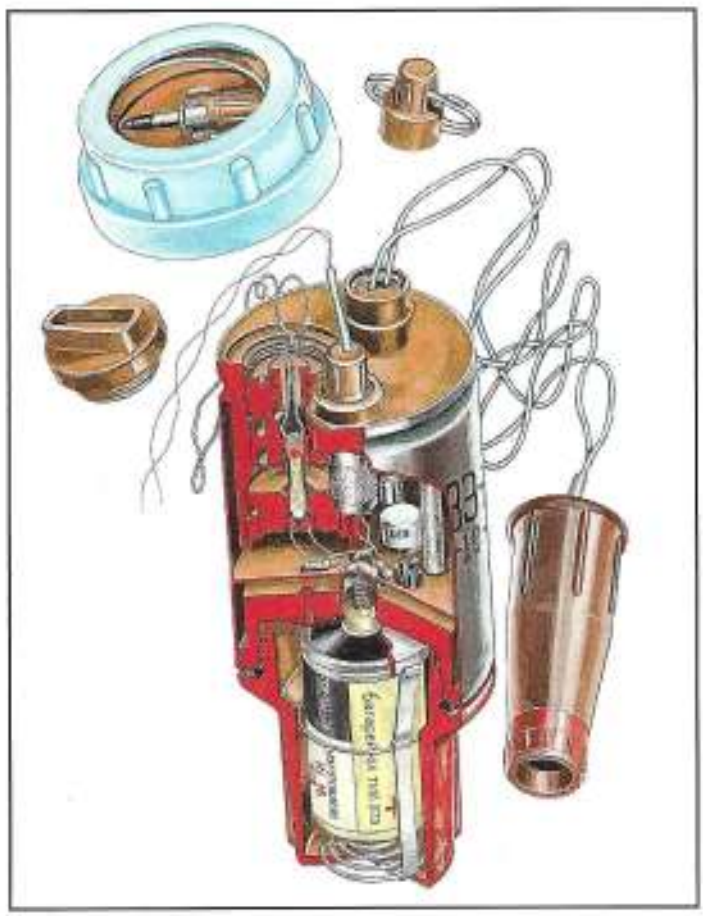
This Yugoslav Special Electronic Fuze had been placed inside an AT mine in Bosnia (Colin King) 0056005



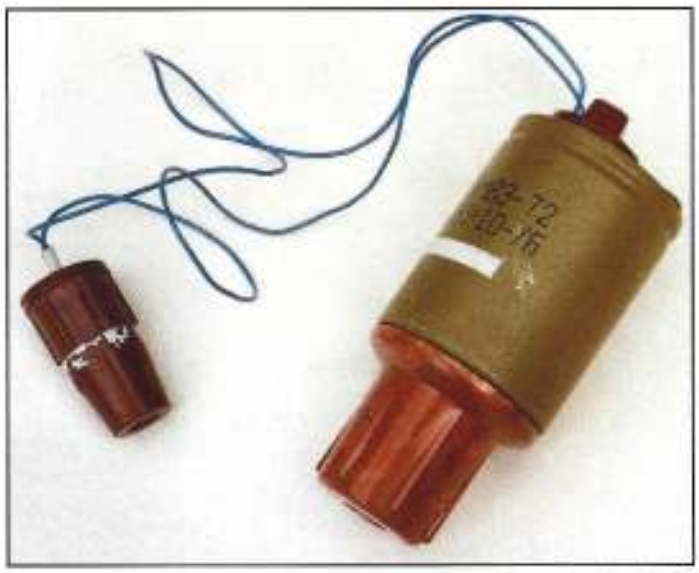
Cutaway diagram of a light-sensitive Special Electronic Fuze (Lyn Haywood) 0074137



The Russian MS-4 can operate by tilt, delay or vibration and incorporates a small HE charge (Lyn Haywood) 0074667



Cutaway diagram of the Russian MVE-72 (Lyn Haywood) 0074138



MVE-72 is an electronic device designed to initiate mines using breakwire (Colin King) 0018958

ELECTRICAL AND ELECTRONIC BOOBY TRAPS

Description

For many years the former Warsaw Pact used booby traps which incorporated simple electrically powered firing circuits, and some of these are still in use today. More recently, electronics has allowed a far greater variety of operating principles and the incorporation of multiple options. For practicality, all military electrically powered booby traps use batteries, which have a limited, though unpredictable, lifespan. Most use a capacitor discharge system for initiation, and in some cases, the device can operate even when the battery has expired or been removed because of the charge stored in the capacitor. For logistic convenience and concealment, most modern systems are designed to be as small as possible. Many have plastic casings, but circuitry and batteries provide sufficient metal content to make them easily detectable. Most switches simply provide a pulse for the initiation of an electric detonator, and contain no explosive charge.

Older Russian devices, like the NVU-P (VP-12) and the MVE-72, are housed in bulky tubular steel casings, while more modern designs use smaller plastic boxes or drums. Most allow access to the batteries so that they can be removed for storage or changed when necessary, and all are waterproofed to protect the circuitry from the effects of damp. The advent of electronics has allowed booby traps to be initiated by a variety of influences, in addition to the physical movement of people and objects. Passive sensors may respond to light, heat, noise level or even the seismic signature of footsteps (as the Russian NVU-P is designed to do). Where possible, the sensor is incorporated into the casing of the device, though components such as geophones and detection coils tend to be remote from the control box. Unlike mechanical switches, where the initiator is normally attached directly to the device, electrical booby traps generally have protruding wires for connection to an initiator, allowing more flexibility in placement. Devices with collapsing circuits initiated by 'breakwire' also have the fine wire itself, or connecting leads, protruding from the casing.

Operational details

Typical operation

Simple electrical booby traps tend to function on the same principles as mechanical booby traps (pressure, pull and pressure-release), but using the movement to complete a circuit. Electronic traps may have optional thresholds set at the factory or by the user and invariably include an arming delay to permit the setter to assemble the trap and escape in complete safety. During the arming delay some switches are capable of 'zeroing' themselves to their surroundings. An advanced tilt switch, for example, may be placed on a slope and will register that orientation as its datum once it becomes armed. At the end of the arming delay the initiator is fired when the appropriate stimulus exceeds the threshold. The vast majority of traps initiate a standard electric detonator, although devices (such as the Russian NM initiator) can be used to translate electrical output into the mechanical impulse needed to fire a stab-receptor.

Electronic timers are covered separately, since they are not victim-activated devices; see *Delay devices*.

EOD considerations

- Disarming booby traps normally entails significant risk, and some mechanisms are particularly sensitive
- Battery life is highly unpredictable, and some fuzes may be capable of functioning even when the battery has been removed
- Booby traps may be attached to large charges, remote from the fuze location
- It is not normally advisable to initiate a booby trap deliberately; where possible, a proper demolition should be set up
- If a booby trap is to be deliberately initiated, its full extent must be known before any EOD action is taken
- After any EOD action, a 'soak time' (remaining a safe distance from the target) should be allowed
- Booby traps are normally pulled or demolished in place; they are disarmed only if there is no alternative
- Clearance procedures should be carefully reviewed in situations where booby-trapping is suspected
- Cryogenics can be used to lower battery power temporarily, but electronic devices may be initiated.

Typical specifications

Example	Russian MVE-72	Russian MS-4	Yugoslav Special Electronic Fuzes
Operation:	Breakwire	Tilt, vibration and time delay	Options include: Breakwire, acoustic, tilt, delay, inertia, light, thermal, vibration
Diameter/length:	63 mm	154 mm × 90 mm	95 mm
Height:	145 mm	30 mm	37 mm
Output:	Electricalto NM initiator (squib-propelled firing pin)	117 g HE	Electrical, to standard electric detonator

Notes

As with mechanical fuzes, electrically powered booby traps are normally used to initiate secondary charges or other munitions; since interference may begin a secondary delay or initiation sequence, an adequate 'soak time' must be allowed following any EOD action. Some booby traps have an explosive content and can therefore function as stand-alone devices, but these generally have a small charge intended for a blast effect only.

For more detailed information about specific booby traps, see *Jane's Mines and Mine Clearance*.

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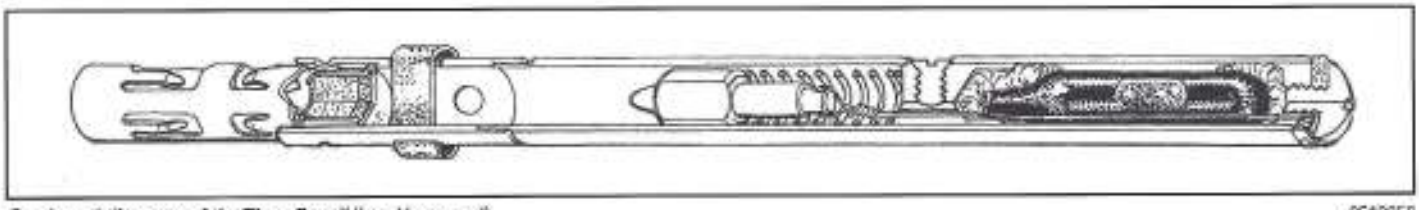
The Yugoslav SU-24c-M83 is a clockwork delay fuze intended primarily for use with limpet mines (Colin King) 0056006

The Russian VZD-6Ts is a 6-hour clockwork timer (Colin King) 0074764

EKhV-7 is a Russian electro-chemical delay device used in Afghanistan (Colin King) 1121169

Russian MUV-4 mine fitted with an MD-5M detonator assembly. This fuze incorporates a hydraulic delay using a piston drawn through a silicon gel by the firing pin spring (Colin King) 0021182

British No 10 Mk 1 (chemical delay) 'Time Pencil' (Colin King) 0018960



Sectioned diagram of the Time Pencil (Lyn Haywood) 0512658

DELAY DEVICES

Description

Since delay fuzes are designed to function after a given period rather than being victim-activated, they are not strictly defined as booby traps. The delay may be either fixed or variable. Short, fixed delays are ideal for arming mines, and simple mechanisms are therefore incorporated into mine fuzes such as the Russian MUV-2 and MUV-4. This type of fuze can then be used either for delay initiation or for arming a pressure- or pull-actuated mine. Mechanical long-delay timers (more than 24 hours) have very limited application and are rarely used as stand-alone booby traps, though electronic timers can easily offer the facility for long delay at no extra production cost. Delay fuzes do not generally contain explosive, though they may be linked to any type of charge. The main exceptions are stand-alone sabotage devices, such as limpet mines, which are basically demolition blocks fitted with delay initiation mechanisms. Delay fuzes tend to contain a significant amount of metal and are therefore readily detectable.

Operational details

Typical operation

Delay fuzes employ a wide variety of principles and configurations. Some of the most reliable fixed delays are purely mechanical, using lead-shear or a viscous gel in a 'dash-pot', while others rely on chemical effects, such as the erosion of a retaining wire. These types are not suitable for precise timing or long delays; they tend to use helical springs as their power source and are generally cylindrical. In some lead-shear devices, several lead tablets of varying thickness or hardness are provided to allow a range of delay options. The most common variable delays still use clockwork, though these are gradually being replaced by electronic timers. Variable timers tend to be larger than the simple fixed delay fuzes, and the casings tend to be more box-like. Some odd variations, using electromechanical and electrochemical-mechanical delays, have also been manufactured.

Most fixed-delay fuzes incorporate cocked strikers; once fitted with an initiator and set up with a secondary charge, they are normally armed simply by the removal of a retaining pin. Fixed delays, such as those using lead-shear mechanisms, tend to be inconsistent and can vary substantially with vibration and temperature. Clockwork mechanisms are not generally stored ready for use, and must be wound by turning a dial or key before selecting the required delay. Chemical-mechanical fuzes of the 'Time Pencil' type have a glass ampoule within the fuze body which is broken to begin the delay by eroding a striker-retaining wire; there is also a safety pin or bar that must be removed. When the delay has expired, the spring-loaded striker is released onto a percussion cap or stab-receptor to initiate the explosive train.

In addition to initiating charges directly, these devices may be used as an arming delay for a munition which incorporates another means of initiation.

EOD considerations

- Most delay fuzes give no indication of the length of time remaining before initiation
- Some delay fuzes incorporate anti-handling devices
- Jammed mechanical timers may be restarted by movement
- Delay fuzes may be attached to large charges, remote from the fuze location
- If a booby trap is to be deliberately initiated, its full extent must be known before any EOD action is taken
- After any EOD action, a 'soak time' (remaining a safe distance from the target) should be allowed
- Once set, delay fuzes should never be approached unless there is no alternative.

Typical specifications

Example	British Time Pencil	Russian MUV-4	Yugoslav SU-24c-M83
Operation:	Chemical	Hydraulic dash-pot	Clockwork
Diameter/width:	10 mm	17 mm	72 mm
Length:	105 mm	117 mm	90 mm
Delay:	Approx 20 min–5 days	Approx 1–30 min	1–24 h

Notes

Limpet mines and other sabotage charges are normally placed against their targets and are therefore designed for a blast effect. Like booby traps, delay fuzes are generally intended to detonate a secondary charge and may contain little or no explosive, however, there is no limit to the size or type of charge that they may be used to initiate. Since interference may begin an initiation sequence or secondary delay, an adequate 'soak time' must be allowed following any EOD action.

For more detailed information about specific booby traps, see *Jane's Mines and Mine Clearance*.

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First World War British 8 in 'Livens Bombs', drilled to sample the chemical agent. These were electrically fired from mortar tubes and contain a small explosive burster charge (Colin King) 0074642

The M426 was the chemical version of the 8 in US M106 projectile (Colin King/DEODS) 0529600

Yugoslav M79 AF1 CS grenade bodies (Colin King) 1121168

155 mm chemical projectiles (Colin King) 1289964

A sectioned First World War era chemical projectile. Note the thin casing and central burster tube (Colin King/DEODS) 0673778

A First World War German chemical mortar bomb; note the filler plug on the ogive (Colin King) 1342326

A First World War German 21 cm projectile containing a bottle, which was filled with DA agent (Colin King) 1374643

CHEMICAL WEAPONS

CHEMICAL MUNITIONS

Description

Chemical weapons were refined and used extensively during the First World War, although the munitions were largely confined to artillery projectiles and mortars. Several countries continued to develop and stockpile chemical weapons, but by far the greatest activity was in the United States and the former Soviet Union. Chemical agents can be dispersed from virtually any category of munition and have included landmines, projectiles, bombs and surface-to-surface missiles. Although some chemical weapons have been deployed since the First World War, their use has been limited. Chemical weapons were banned by the 1993 Chemical Weapons Convention (CWC) and most stockpiles are now undergoing destruction; this work is due for completion by 2012. Although some nations believed to hold chemical weapons have not signed or ratified the CWC, the only types still in widespread use are hand grenades and projected grenades containing riot agents, which are available to the military and police in many countries.

The munition casing is normally thin-walled and, in most instances, incorporates an obvious filling plug. Although some chemical munitions (such as the 'Livens Bomb') are readily identifiable, in many cases the shape and overall appearance of the munition is conventional and will not allow positive recognition. Colour codes are normally used to distinguish chemical-filled munitions; these are summarised in the *Identification* section.

Operational details

Typical operation

Most chemical munitions with toxic fillings can be categorised as 'carriers', with the body of the munition simply acting as a reservoir for liquid agent. The munition casing is normally thin-walled and may enclose a liner or an inner container. Although some have conventional impact or delay fuzes, more advanced munitions use proximity fuzing for an airburst effect, thereby maximising the spread of agent over the target area. The release of agent is normally achieved using a central HE burster charge that splits the outer casing and expels the agent. Since many agents are destroyed by excessive heat, the size and type of the burster is carefully designed not to incinerate the filling.

Early Livens bombs used fly-off levers (of the hand-grenade type) to initiate a length of safety fuse, which then detonated the central burster charge to split the thin steel casing and distribute the liquid agent. Later variants incorporated all-ways acting percussion fuzes, making them sensitive to shock if they failed to function as intended.

'Binary' munitions (such as the US BLU-80 'Bigeye' bomb) contain two non-toxic compounds that combine to produce a chemical agent when the weapon is deployed.

Non-toxic riot agents are normally in solid form for use in grenades, although aerosols are also sometimes used. 'CS' is the most common, and is dispensed as a smoke when a pyrotechnic composition is ignited.

EOD considerations

- Proper protective equipment must be worn during weapon reconnaissance
- Detection equipment should be used to identify the presence or type of agent
- Proximity fuzes should not be approached within their 'field of view'
- Some munitions (such as Livens bombs) may be fitted with all-ways acting fuzes
- Approaches should be made from upwind
- HE burster charges may be present
- The type of agent should be confirmed and the downwind hazard area calculated before a disposal option is selected
- Specialist training and equipment are needed for the safe disposal of chemical munitions.

Typical specifications

Category	Grenade	Projectile	Bomb
Example:	Yugoslav M79 AF-1	US M426	Russian KhAB-500 R-5
Overall weight:	236 g	90.26 kg	300 kg
Length:	106 mm	892 mm	2.4 m
Diameter:	74 mm	203 mm (8 in)	450 mm
Filling type:	CS	GB or VX	H or HL
Filling weight:	112 g	6.58 kg	175 kg
HE burster:	4 g	3.2 kg	10 kg (est)

Notes

See also *Disposal options* and separate entries listing the designations and characteristics of common chemical agents. National production tables for chemical bombs are contained in entries under *Other bomb types* in the *Data summary* section. All US chemical weapons have been withdrawn from service.

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Tubes containing training samples of chemical agents (Colin King) 1041021

Training samples of CS, DM and Chloropicrin (Colin King) 1288955

CHEMICAL AGENT DESIGNATORS

The following table is a summary of the chemical agents most likely to be used in munitions; in each case, a common name is given, but most agents have a variety of alternative designations and chemical names. Additional details on these agents, and methods for their disposal, are given in separate entries within this section. For chemical munition colour codes, see the *Identification* section.

Type of agent	Designation	Name	Notes
Blister	CX	Phosgene oxime	Crystalline solid with low melting point
	ED	Ethyldichloroarsine	Low volatility liquid
	H	'Levinstein' mustard	Low volatility brown liquid
	HD	Distilled mustard	Liquid distilled from H
	HL	Mustard-lewisite mixture	Low volatility liquid
	HN-1 and 2	Nitrogen mustard	Low volatility liquids
	HN-3	Nitrogen mustard	Low volatility liquid, more persistent than HN-1 and 2
	HT	Mustard-T mixture	Low volatility liquid
	L	Lewisite	Medium volatility liquid
	MD	Methyldichloroarsine	Volatile liquid
	PD	Phenyldichloroarsine	Moderately volatile liquid, also causes vomiting
Blood	AC	Hydrogen cyanide	Highly volatile liquid
	CK	Cyanogen chloride	Volatile liquid
	HCN	Hydrogen cyanide	An alternative designation for AC
	SA	Arsine	Liquid
Choking	CG	Phosgene	Liquid with low boiling point
	DP	Diphosgene	Liquid with high boiling point
	PFIB	Perfluoroisobutene	Vapour; toxic in minute quantities
Nerve	GA	Tabun	Colourless or light brown liquid
	GB	Sarin	Colourless liquid
	GD	Soman	Colourless liquid
	GF	CMPF (cyclohexyl methyl phosphonofluoridate)	Colourless liquid
	VE, VG, VS, VX	'V-agents'	Colourless liquids with low volatility
Lachrymatory	BBC	Bromobenzylcyanide	Non-toxic liquid
	CN	Chloroacetophenone	Non-toxic, often used in aerosol form
	CNB	Solution of CN in benzene and carbon tetrachloride	Non-toxic liquid
	CNC	Solution of CN in chloroform	Non-toxic, used in aerosol form
	CNS	Mixture of CN, chloroform and chloropicrin	Long-lasting toxic effects
	CS	O-chlorobenzalmalononitrile	White crystalline solid; usually dispensed as a smoke
Incapacitating	BZ	Benactyzine	Crystalline solid
Vomiting	DA	Diphenylchloroarsine	Used in aerosol form
	DC	Diphenylcyanoarsine	Used in aerosol form
	DM	Adamsite	Crystalline solid, used in aerosol form
	PS	Chloropicrin	Normally a pale oily liquid, also causes choking
Training	MR	Simulated mustard	Harmless blister agent simulant

Non-living toxins, such as Ricin and Botulinum, are also classed as chemical agents by the United Nations, and for the purposes of the Chemical Weapons Convention (CWC).

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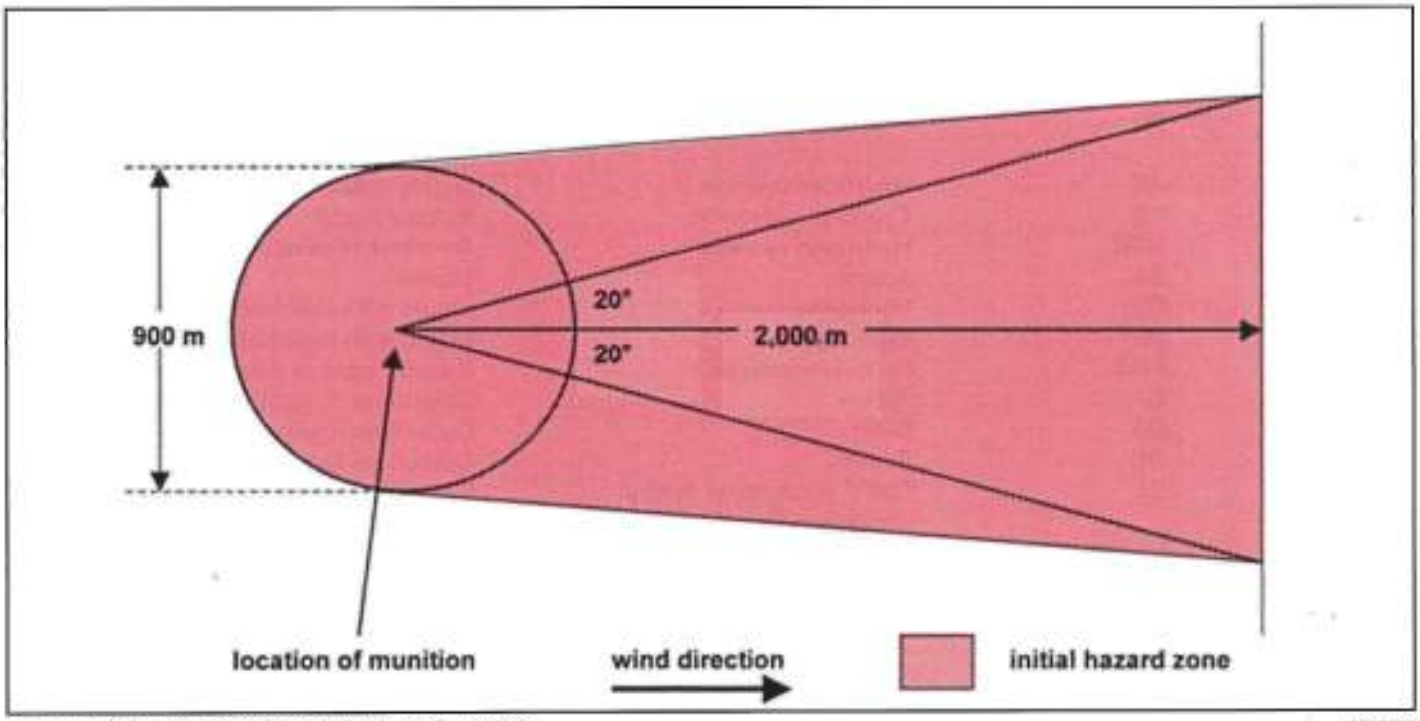
Testing the agent in leaking chemical bomb using 3-colour detector paper (Colin King) 0074643

Packaging the sealed bomb. This process results in prolonged exposure, requiring special suits and self-contained breathing apparatus (Colin King) 0074644



The construction of an initial downwind hazard template 0529558

Several nations have the capability to conduct chemical reconnaissance and mark contaminated areas from within protected vehicles 0050702

CHEMICAL WEAPON RECONNAISSANCE

Introduction

If the presence of chemical ordnance is suspected, then reconnaissance is needed to characterise the threat. The extent of the contaminated area is normally established using specially trained personnel equipped with purpose-built vehicles, many of which incorporate marking systems to delineate the danger area. If an unexploded chemical munition is located, this may become an EOD responsibility, requiring detailed close reconnaissance by the EOD team. Chemical weapon reconnaissance is a specialist task that can only be performed by personnel with appropriate training and equipment; the process is complex and this entry gives only a brief overview. For more details on chemical detection, reconnaissance and protective equipment, see *Jane's Nuclear, Biological and Chemical Defence*.

Approach

Wherever possible, a suspect chemical munition will be approached from upwind, by a single operator wearing protective equipment. If a brief reconnaissance is anticipated, a general-purpose chemical protective suit and respirator may be deemed adequate; for longer periods or particularly high-risk environments, a special protective suit and self-contained breathing apparatus may be needed. The operator will carry one or more means of detection, which may include detector paper, an electronic detector, or a manual air-sampling system (such as a type incorporating small tubes containing reagent). A notebook or camera should also be available to record details of shape, dimensions and markings on the munition. If the munition is believed to be leaking, sealing equipment may also be taken.

Threat assessment

The primary objectives of the reconnaissance are to identify the munition and type of agent (often from markings), but a good deal of additional information is also needed. This includes factors such as:

- Whether the munition is leaking
- The type of fuze
- Whether a burster charge is present
- Additional hazards, such as collapsed structures or other unexploded ordnance
- The type of ground and direction of slope
- Access to the munition
- Surrounding obstacles, structures, services and vegetation
- Prevailing weather conditions, wind direction and near-term forecast.

Once the agent type and weather conditions are known, a downwind hazard template must be calculated and superimposed on a map to ensure that the disposal location is suitable. Once again, special instruments are available to create an accurate downwind hazard template, but a 'hasty' template can be drawn immediately, as shown in the diagram. This consists of a circle of 900 m diameter drawn around the location of the munition, with a downwind area extending to 2000 m covering an arc 20° either side of the wind direction. The outer points of the arc are then connected to the edge of the circle to create an approximate hazard template; where possible, this should be adjusted according to the type of agent, wind speed, temperature gradient and the size of the munition.

Final Disposal

In most countries during peacetime, the disposal of chemical munitions is tightly regulated and confined to purpose-built facilities. During, or immediately following hostilities, a number of techniques exist for field disposal; these are covered under a separate entry, *Disposal options*, in this section.

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DISPOSAL OPTIONS

Introduction

The disposal of chemical munitions is a specialist task that should only be undertaken by EOD personnel or first responders that have been specifically trained and equipped for the role. This entry gives a brief overview of the options, but does not cover the many factors and detailed procedures involved in the disposal of chemical weapons. The field disposal of chemical munitions is normally confined to hostilities or the immediate aftermath; obvious safety and environmental concerns mean that, in most countries, peace-time disposal is tightly regulated and requires purpose-built facilities.

There are three major options for the disposal of chemical munitions in the field. These are:

- Venting
- Incineration
- Chemical neutralisation.

Preparation

Before disposal can begin, a close reconnaissance is required to determine the type of munition and agent, along with other important details, such as secondary hazards and ground conditions; the downwind hazard area should also be calculated, or estimated using a basic template. These elements are outlined in a separate entry, *Chemical weapon reconnaissance*. The disposal site should be carefully selected to ensure that chemical agents will not be carried towards inhabited areas or contaminate water supplies. Since many agents are heavier than air and persist among vegetation, every effort should be made to find a site that is clear and level. Weather conditions are also critical; the warm (above 20°C) rising air present during 'lapse' conditions is ideal, with light winds (less than 10 kph). The least suitable weather condition is an 'inversion', where cold air stays close to the ground and will prevent the rapid dispersal of chemical agent; this condition often exists at night and during early morning.

Leak sealing and packaging

A leaking chemical munition should be sealed quickly to avoid further loss of agent, prior to packaging or disposal. Almost any type of sealant can be used, including epoxy resin, Plaster of Paris bandage, adhesive tape or shaped plugs, although adhesion to wet, dirty and rusty surfaces is often a problem. Precautions should be taken to minimise the threat of the munition functioning, since even a small HE burster would breach the packaging and disperse chemical agent. The surface of the sealed munition should be decontaminated and checked for further leakage. Where possible, munitions are then wrapped in at least two layers of plastic sheeting, and the whole assembly placed in a hermetically sealed container. Shock absorbent material should be placed in the container to avoid further damage to the munition and, ideally, an absorbent medium such as Fuller's Earth will be used. Once packaged, munitions must be clearly marked with the type of munition and agent, explosive content (if any), date and time, name and contact details of the packer, a 'this way up' indication, the packing location and the type of decontaminant or other safety measure used. The package must be checked periodically for leakage and final disposal should occur as soon as possible. Cooling (using Carbon Dioxide, for example) may also be used to minimise leakage by lowering the agent's vapour pressure, particularly if liquid agent can be frozen.

Venting

Venting is normally considered only for small quantities of gaseous or highly volatile compounds (such as blood and choking agents), under good weather conditions. A small hole is made in the casing of the munition, allowing it to vent into the atmosphere in a controlled manner. In the field, the easiest way to pierce the casing is the remote initiation of a small 'point focal' shaped charge, but other options include unscrewing sealing plugs, drilling, and projectile attack. For venting, more than any other disposal option, it is essential that an appropriate area is selected, and that weather conditions are suitable; venting should never be conducted during an 'inversion'. Nerve agents should never be disposed of by venting.

Incineration

Blister and nerve agents can be destroyed by burning using a special procedure sometimes known as 'vent and burn', in which the munition must be simultaneously punctured and incinerated. The munition is positioned on a substantial quantity of combustible material, normally contained in a pit and soaked in diesel or kerosene. A shaped charge on the munition is linked to blast incendiaries, used to ignite the material in the pit. The circuit is wired in series to ensure that one type of charge cannot function without the other. On firing, the munition is punctured by the shaped charge and immediately engulfed in the fireball from the blast incendiaries; the sustained burn of the material in the pit then evaporates and destroys any remaining agent. Once cool, the pit must be checked for any residual contamination or explosive hazard.

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Neutralisation

Certain compounds react with chemical agents to render them inactive, making neutralisation a viable option for most liquid agents. The chemical munition must be opened or punctured, and its filling dispensed into the neutralising compound in a controlled manner. Since some of the reactions are strongly exothermic, it is essential that the agent is released slowly, and that sufficient neutralising compound is available. The container must be robust, insoluble in organic compounds, and heat-resistant. As a precaution, the 'worst case' downwind hazard area (assuming the escape of the entire filling) should be calculated. An example of an improvised set-up for neutralisation is shown in the photograph.

Chemical agents, together with the appropriate neutralising compounds, are listed in the table.

	Sodium Hydroxide	Sodium Carbonate	Supertropical Bleach	Sodium Hypochlorite	Calcium Hypochlorite	Sodium Hydroxide solution in alcohol
AC	*					
BZ						*
CG	*					
CK	*					
CN						*
CS						*
CX			*	*	*	
GA	*	*	*			
GB	*	*	*			
GD	*	*	*			
GF	*	*	*			
H			*	*	*	
HD			*	*	*	
HL			*	*	*	
HN			*	*	*	
HT			*	*	*	
L			*	*	*	
MD			*	*	*	
PD			*	*	*	
VX	*		*	*	*	

Improvised neutralisation set-up. The detonating cord simultaneously initiates the point focal shaped charge (to penetrate the casing) and releases the steel scaffold poles, allowing the projectile to drop into the steel tank containing the neutralising agent (Colin King, courtesy of DEODS) 0074654

BLISTER AGENTS (VESICANTS)

Vesicating (blister-causing) agents were among the first CW agents and are primarily designed to cause casualties. Blister agents are generally highly persistent, although they are slow to take effect. External contact results in painful wounds requiring sustained treatment, while ingestion is likely to be fatal.

During the First World War the principle blister agent was sulphur ('Levinstein') mustard (H agent). Later in the war, its delayed effect was crudely overcome by mixing the vesicant with faster acting choking agents and vomitants, which caused troops to remove their respirators. Modern respirators and impermeable body protection are highly effective against these agents.

The impact of blister agents on the immune system and on the environment is significant. Research on the long-term effects of vesicants used on unprotected civilians in Iraq (at Hallabjah in 1989) reveals that mutagenesis is probably more severe than that caused by nuclear radiation. Large-scale disposal of vesicant munitions in the Denmark Strait after the Second World War continues to cause injuries to fishermen. Unlike most other types of CW agent, vesicants, especially H agent, are extremely slow to hydrolyse in salt water and the agent forms a 'cake', denser than seawater, which remains highly toxic. Fishing trawls continue to retrieve the material and cause burn injuries. Disposal of the material is difficult, although small quantities can normally be burned or neutralised using strong alkalis, such as bleach (see *Disposal options*).

CX: Phosgene Oxime or Dichloroformoxime

CX is a blister agent, which may appear either as a colourless, low-melting point (crystalline) solid, or as a liquid. It has a high vapour pressure, slowly decomposes at normal ambient temperatures (the rate also depending on humidity), boils at 53 to 54°C, melts at 39 to 40°C and is readily soluble in water. It has an unpleasant, penetrating odour.

CX is a powerful irritant, which produces immediate pain, varying from a mild prickling sensation to a feeling resembling a bee sting. It causes violent irritation to the mucous membrane of the eyes and nose. When it comes in contact with the skin, the area becomes blanched in 30 seconds and is surrounded by a red ring. A wheal forms in about 30 minutes and the blanched area turns brown in approximately 24 hours, with a scab forming in about one week. The healing process can take more than two months.

For disposal, CX can be burned or neutralised using strong alkalis such as supertropical bleach, sodium hypochlorite and calcium hypochlorite (see *Disposal options*).

ED: Ethyldichloroarsine

Ethyldichloroarsine (ED) is a blister agent that was introduced by the Germans in March 1918. Their aim was to produce a volatile agent with a short duration of effectiveness which would act faster than diphosgene (DP) or distilled mustard (HD), yet have more lasting effects than phenyldichloroarsine (PD). It evaporates at approximately the same rate as water, has a fruity but irritating odour, and may be used in either liquid or vapour form. The agent has a short duration under wet conditions.

Liquid ED has approximately one twentieth the blistering action of liquid lewisite (L). The vapour will irritate the eyes, respiratory tract and skin, but only causes blistering on prolonged exposure. The absorption of either vapour or liquid through the skin in sufficient amounts may lead to systemic poisoning or death. For disposal ED can be burnt or neutralised using a strong alkali (see *Disposal options*).

H: 'Levinstein' Mustard

'H' is the name for a mustard blister agent made by the 'Levinstein process'. It contains about 30 per cent sulphur impurities, which give it a pronounced odour. The properties of H are essentially the same as those listed for distilled mustard (HD).

'Dusty' mustard, also referred to as micronised mustard, is a refined mustard agent absorbed into a diatomaceous earth.

For disposal, H can be burned or neutralised using strong alkalis such as supertropical bleach, sodium hypochlorite and calcium hypochlorite (see *Disposal options*).

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HD: Distilled Mustard

Distilled mustard (HD) is blister agent 'H' ('Levinstein mustard') which has been purified by washing and vacuum distillation; its chemical name is 2,2'-dichloro-diethyl sulphide. HD has slightly greater blistering power, less odour, and is more stable in storage than H. In liquid form, the agent may persist for one to two days under temperate conditions and for a week or more during cold weather. It has an odour like garlic and, even in low concentrations, quickly affects the eyes, causing conjunctivitis and inflammation. Other symptoms may not appear for 4 to 6 hours and are sometimes delayed even longer; the rate of action is normally proportional to the concentration of the agent. HD blister injuries heal more slowly than those of most other agents, since blood vessels are damaged and dead tissue often becomes infected.

For disposal, HD can be burned or neutralised using strong alkalis such as supertropical bleach, sodium hypochlorite and calcium hypochlorite (see *Disposal options*).

HL: Mustard-Lewisite Mixture

HL is a blister agent made by mixing distilled mustard (HD) and lewisite (L); this creates a low-freezing composition for use in cold weather operations, or as a high-altitude spray. The eutectic mixture (the mixture having the lowest possible freezing point) is 63 per cent L and 37 per cent HD by weight, although other mixtures may be prepared for specific weather conditions. In liquid form, the agent may persist for one to two days under temperate conditions and for a week or more in very cold weather. In mixtures with Lewisite, HD is used in preference to 'Levinstein mustard' (H) because of its superior storage characteristics.

HL has a garlic-like odour and produces immediate stinging on contact with skin or eyes. Redness on skin occurs within 30 minutes, although blistering is normally delayed about 13 hours. Contact with the eyes causes severe damage. Liquid on the skin, as well as inhaled vapour, is absorbed and may cause systemic poisoning resulting in death.

For disposal, HL can be burned or neutralised using strong alkalis such as supertropical bleach, sodium hypochlorite and calcium hypochlorite (see *Disposal options*).

HN-1, 2 and 3: Nitrogen Mustards

The nitrogen mustards, HN-1, 2 and 3, are closely-related blister agents. These compounds are based on ammonia, in which hydrogen atoms around the nitrogen are replaced by organic radicals. They have a faintly fishy or musty odour and produce eye irritation in low vapour concentrations; liquid or prolonged vapour contact is required to cause significant skin damage. HN-1 and HN-2 are slightly less persistent than distilled mustard (HD) and may not cause major symptoms for 12 hours or more. HN-2 is the most effective in vapour form, but is too unstable for long-term storage in chemical weapons. Of the three compounds HN-3 is the most stable in storage and, therefore, most suitable for use in munitions; it is substantially more persistent than HD and normally produces symptoms within 4 to 6 hours.

For disposal, any of the nitrogen mustards can be burned or neutralised using strong alkalis such as supertropical bleach, sodium hypochlorite and calcium hypochlorite (see *Disposal options*).

HT: Mustard-T Mixture

HT is a blister agent mixture made from 60 per cent distilled mustard (HD) and 40 per cent Agent T (a sulphur and chlorine compound similar in structure to HD). Agent T is a clear yellowish liquid with an odour similar to HD. HT has a strong blistering effect and a longer duration of effectiveness, greater stability and a lower freezing point than HD. The injuries caused by HT are essentially the same as those of HD; it causes eye irritation, delayed appearance of blisters and is toxic when inhaled. HT is a persistent agent which, in liquid form, lasts one or two days in temperate weather and a week or more under cold conditions. Its low volatility means that HT has relatively little vapour hazard.

For disposal, HT can be burned or neutralised using strong alkalis such as supertropical bleach, sodium hypochlorite and calcium hypochlorite (see *Disposal options*).

L: Lewisite

Lewisite (dichloro (2-chlorovinyl) arsine, or chloroethenyldichloroarsine) is a blister agent with roughly the same effect on the skin as distilled mustard (HD), although the lethal dosage for L is much higher. Lewisite is normally a mixture of 3 major isomers; its composition and characteristics can therefore vary slightly. In addition to its blistering effect, it is a toxic lung irritant and, when absorbed in the tissues, a systemic poison. When inhaled in high concentrations it may be fatal in as little as 10 minutes. The liquid L causes an immediate searing sensation in the eye and, if not decontaminated within 1 minute, permanent loss of sight. It also produces an immediate and strong stinging sensation to the skin; reddening of the skin starts within 30 minutes, but blistering does not appear until after about 12 hours. Skin burns are much deeper than with HD and sufficient absorption can lead to liver failure. Its persistence is a little shorter than HD and is greatly reduced under humid conditions.

For disposal, Lewisite can be burned or neutralised using strong alkalis such as supertropical bleach, sodium hypochlorite and calcium hypochlorite (see *Disposal options*).

MD: Methyldichloroarsine

MD (methyldichloroarsine) is a blister agent similar to ethyldichloroarsine (ED), but with no odour. Its effect on eyes is similar to that of lewisite (L), resulting in corneal damage, but less severe, while its blistering action is slightly less than that of distilled mustard (HD). MD produces immediate irritation of eyes and nose, but the blistering effect (resulting from prolonged contact with either liquid or vapour) is normally delayed several hours. As with L and the other similar arsenicals, MD is irritating to the respiratory tract and is likely to result in lung injury. The absorption of sufficient vapour or liquid through the skin may lead to systemic poisoning or death. Since the agent is more volatile than water, persistence is relatively short.

Like other blister agents, MD can be burned or neutralised using strong alkalis such as supertropical bleach, sodium hypochlorite and calcium hypochlorite (see *Disposal options*).

PD: Phenyldichloroarsine

PD (phenyldichloroarsine) is an obsolete chemical agent, which saw limited use during the First World War; it is generally classified as a blister agent, but also causes vomiting. It is odourless, but affects the eyes immediately; effects on the skin are normally delayed between 30 minutes to 1 hour. PD is approximately 30 per cent as toxic to the eyes as distilled mustard (HD). On bare skin PD has almost as much blistering power as HD, but decomposes immediately on contact with wet clothing. It is slightly less persistent than HD in the dry and has a very short duration in wet conditions.

As with other blister agents, PD can be disposed of by burning or neutralised using strong alkalis such as supertropical bleach, sodium hypochlorite and calcium hypochlorite (see *Disposal options*).

BLOOD AGENTS

Blood agents can be dispersed in liquid or gaseous form and are absorbed into the body primarily through inhalation. They affect bodily functions through action on the enzyme cytochrome oxidase, preventing the normal transfer of oxygen from the blood to body tissue. Their military utility lies in quick effect followed by rapid dispersal, so they are generally non-persistent.

Blood agents are neutralised in contact with sodium hydroxide. Their volatility means that, under favourable conditions, they can also be disposed of by venting (see *Disposal options*).

AC: Hydrogen Cyanide (also known as HCN)

Hydrogen cyanide is a blood agent with an odour similar to peach kernels and a very rapid action. It is also known by its chemical formula, HCN and its chemical name, methanenitrile. It initially causes a marked stimulation of the breathing rate, with death typically occurring within 15 minutes of a lethal dosage. AC interferes with the utilisation of oxygen by body tissues through the inhibition of the enzyme cytochrome oxidase. It can also be used to degrade the performance of respirator canisters and other chemical agent filters. A variation of AC in powdered form, known as Zyklon B, was used in the German extermination camps during the Second World War. As a pale blue liquid, the agent is highly volatile (non-persistent) and, in the gaseous state, is colourless and lighter than air.

AC is neutralised by contact with sodium hydroxide and can be vented in small quantities under favourable weather conditions (see *Disposal options*).

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CK: Cyanogen Chloride

Cyanogen chloride or chloroformonitrile (CK) has the formula CNCl. It is primarily a blood agent, which is highly irritating to eyes and mucous membranes; in fact, its irritating and lachrymatory properties are so great that the odour often goes unnoticed. It acts rapidly, in the same manner as hydrogen cyanide (AC), interfering with the utilisation of oxygen by the body tissues, but differs from AC in that it has a choking effect, a strong irritating effect and causes a slowed breathing rate. Like AC, CK can penetrate or inhibit the action of chemical agent filters. The agent is volatile, but may persist in some environments (such as jungle and forest) for some time under certain weather conditions.

CK is neutralised by contact with sodium hydroxide and can be vented in small quantities under favourable weather conditions (see *Disposal options*).

SA: Arsine

SA (arsenic trihydride) is a blood agent with a mild garlic-like odour, but no skin or eye toxicity. It interferes with blood function, causing anaemia and damage to the liver and kidneys. Slight exposure causes headache and uneasiness; further exposure causes chills, nausea and vomiting. SA is non-persistent and, under favourable conditions, can be disposed of by venting (see *Disposal options*).

CHOKING AGENTS

Choking (pulmonary) agents are dispersed in liquid or gaseous form. They attack the lining of the lungs by damaging the membranes and allowing leakage of fluid from the delicate alveoli. Fatalities of this type have been described as 'dry-land drownings'. Chlorine was one of the first 'war gas' choking agents, but is unlikely to be encountered in modern military chemical munitions. During the First World War, chlorine was replaced by phosgene, which saw widespread use and caused devastating effects. Both gases are non-persistent, and can be vented under favourable conditions (see *Disposal options*).

CG: Phosgene

CG (carbonyl chloride) was the choking agent used most extensively during the First World War, causing more than 80 per cent of chemical agent fatalities. It has an odour similar to newly mown hay or grass and has no skin or eye toxicity. Although high concentrations may produce immediate symptoms, these may be delayed by 3 hours or more after exposure to a low concentration. CG solely affects the lungs and results in damage to the capillaries, causing seepage of fluid into the air sacs. When a lethal dose of CG is received, these become so flooded that air is excluded and the victim dies of anoxia (extreme oxygen deficiency). If proper care is provided after a non-lethal dose, the fluid is reabsorbed, the air cell walls heal and the patient recovers. However, chronic respiratory problems may persist for years. The severity of poisoning cannot be estimated from the immediate symptoms because of the delayed effect, but most deaths occur within 24 hours.

CG is non-persistent, however vapour may persist for some time in depressions under calm conditions and stable atmospheric conditions (inversions). Rain destroys its effectiveness and heavy vegetation degrades the performance of CG by hydrolysis on leaf surfaces.

CG is neutralised by contact with sodium hydroxide and can be vented in small quantities under favourable weather conditions (see *Disposal options*).

Chlorine

Chlorine is a gas which is heavier than air and has an unmistakable pungent odour like bleach. It was used early on in the First World War, initially released directly from cylinders when the wind direction would carry it towards enemy lines; it was later replaced by phosgene, which proved far more effective (see separate entry). Chlorine is non-persistent, but is a powerful irritant, affecting the eyes and respiratory tract. It is no longer considered a viable military chemical agent and is unlikely to be encountered in modern munitions.

DP: Diphosgene

DP (trichloromethyl chloroformate, known as 'diphosgene') is a choking agent with an odour similar to newly mown hay or grass; it has no effect on skin but does produce a slight lachrymatory effect. Although large doses may produce immediate symptoms, these are normally delayed by 3 hours or more after exposure to a low concentration. DP is converted to phosgene (CG) in the body and so the physiological action is the same for both agents; the effect is solely on the lungs and results in damage to capillaries. DP has a higher boiling point than CG, making it less volatile (more persistent) and more suitable for filling projectiles.

DP can be neutralised by contact with sodium hydroxide (see *Disposal options*).

PFIB: Perfluoroisobutene

PFIB is a choking agent, produced when polytetrafluoroethene (PTFE) is burned. It has no odour and no skin or eye toxicity, solely affecting the lungs. After exposure to small doses (measured in parts per million) victims develop headaches, coughs, chest pain and fever within the first hour, with symptoms becoming worse after 6 to 8 hours. Pulmonary oedema can cause death 8 to 48 hours after exposure and even minute concentrations may lead to influenza-type symptoms.

NERVE AGENTS

Nerve agents are colourless to slightly brown liquids with little or no odour; they are divided into two categories known as 'G-agents' and 'V-agents', the latter having greater persistence and toxicity. Nerve agents work by interfering with the balance between the sympathetic (adrenergic) and parasympathetic (cholinergic) nervous systems, which together form the autonomic nervous system. Within the body's nervous system there is normally the controlled destruction of acetylcholine (a product of nerve cell metabolism) by cholinesterase. German scientists discovered that nerve agents react with cholinesterase, leading to the accumulation of acetylcholine and continual stimulation of the nervous system.

In practice, early symptoms include a running nose and increased salivation, tightness of the chest, pinpointing of the pupils, accompanied by dim or blurred vision, and difficulty in breathing. As the effects increase, headache and dizziness are accompanied by excessive sweating. Later effects include nausea and vomiting, involuntary urination and defecation, muscular twitching and eventual stoppage of breathing. Rapid use of 'antidotes' can provide effective protection from nerve agents; autonomic blocking agents, such as atropine salts, act directly on effector nerve cells to nullify the effect of acetylcholine. Where nerve agent is believed to be a threat, military personnel may be issued with atropine 'autojects' (automatic spring-loaded syringes). Atropine is also potentially poisonous (unless used as an antidote), causing some symptoms opposite to those caused by nerve agents.

For EOD purposes, nerve agents can be destroyed either by incineration or neutralised using certain alkaline compounds, but they should never be vented (see *Disposal options*).

GA: Tabun

First discovered in 1936, the nerve agent 'tabun' (ethyl-n-dimethylphosphoroamide-cyanidate) is a colourless to brownish liquid giving a colourless vapour. It normally has a faintly fruity odour, but has none when pure. GA is considered to be approximately 20 times more toxic than CG (phosgene).

GA results in roughly the same sequence of symptoms, regardless of the route by which the agent enters the body (inhalation, absorption or ingestion). These symptoms, in normal order of appearance are: running nose, tightness of chest, dimness of vision and pin-pointing of the eye pupils, difficulty in breathing, drooling and excessive sweating, nausea, vomiting, cramps, involuntary defecation and urination, twitching, jerking and staggering, headache, confusion, drowsiness, coma and convulsions. These symptoms are followed by cessation of breathing and death. The number and severity of the symptoms which appear are dependent on the quantity and rate of entry of the nerve agent; very small skin dosages sometimes cause local sweating and tremors with little other effect. Symptoms appear much more slowly from skin absorption than from vapour inhalation. A lethal dose may be absorbed through the skin in 1 to 2 minutes (although death may be delayed for 1 to 2 hours), so rapid decontamination is essential if there is any contact with the agent. Vapour causes the pupil of the eye to contract, resulting in difficulty in seeing in dim light, or generally distorted vision. Inhaled lethal dosages kill in 1 to 10 minutes and liquid in the eye kills almost as rapidly.

Duration of effectiveness depends upon the munitions used and the weather. Heavily splashed liquid persists one to two days under normal weather conditions. GA can be disposed of by incineration, or neutralised using certain alkaline compounds (see *Disposal options*).

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GB: Sarin

Sarin (isopropylmethylphosphono fluoridate) is a colourless liquid nerve agent with almost no odour when pure. It is considered to be twice as toxic as GA (tabun) (see separate entry) and gives the same sequence of symptoms when inhaled, absorbed through the skin, or ingested. The number and severity of symptoms are dependent on the quantity and rate of entry of the nerve agent; as with GA, very small skin doses may cause sweating and tremors with little other effect. Inhaled lethal dosages kill in 1 to 10 minutes and liquid in the eye kills almost as rapidly. Although a lethal dose can be absorbed through the skin in 1 to 2 minutes, death may be delayed for up to 2 hours.

GB evaporates at approximately the same rate as water. It can be disposed of by incineration, or neutralised using certain alkaline compounds (see *Disposal options*).

GD: Soman

Soman (pinacolylmethylphosphono fluoridate) is a colourless liquid nerve agent with a fruity odour. It is considered to be three times more toxic than GA (tabun). Like tabun and sarin (GB), soman is very toxic to the eyes; vapour causes the pupil of the eye to contract, resulting in difficulty in seeing in dim light and generally distorted vision. Liquid in the eye can kill in less than 10 minutes. Liquid does not injure the skin, but penetrates it rapidly, making immediate decontamination of the smallest drop essential. The symptoms and rate of action are similar to those of GA and GB (see separate entries).

The duration of effectiveness depends on the munitions used and the weather, but heavily splashed liquid may persist for one to two days under normal weather conditions. GD can be disposed of by incineration, or neutralised using certain alkaline compounds (see *Disposal options*).

GF: CMPF

GF (cyclohexyl methyl phosphonofluoridate or 'CMPF') is a colourless liquid nerve agent, said to have a faint fruity odour. Its toxicity and effects are about the same as sarin (GB) (see separate entry) when absorbed through the skin, although it is slightly less toxic in vapour form. It was manufactured by Iraq under Saddam Hussein, although all stocks are believed to have been destroyed. GF is similar in many ways to GB, although it is less volatile (its boiling point is 239°C) and therefore more persistent.

Like the other 'G'-agents, it can be disposed of by incineration, or neutralised using certain alkaline compounds (see *Disposal options*).

V-Agents

V-agents are persistent nerve agents with significantly higher freezing and boiling points than the G-agents (GA, GB, GD and GF). They are typically colourless and odourless liquids and have a fairly limited vapour effect. The most common V-agent is VX (ethyl S-2 diisopropylaminoethyl-methylphosphonothioate), although others (including VE, VG and VS) also exist.

V-agents are usually disseminated in liquid or aerosol form, producing their toxic effects from minute doses absorbed through the skin. In addition to absorption, aerosol V-agents also produce casualties through inhalation. The symptoms and effects of V-agents are similar to those of the G-agents (see separate entries).

Like the G-agents, V-agents can be disposed of by incineration, or neutralised using certain alkaline compounds (see *Disposal options*); they are also readily absorbed by vegetation.

LACHRYMATORY AGENTS

Lachrymatory (tear) agents were first used by the French against German forces in 1914, but were relatively ineffective. They are now used operationally for riot control and for training personnel in chemical agent protection procedures, CS and CN being by far the most common types used. Normally dispersed in smoke or vapour form, these agents are used mainly in hand grenades or low-velocity 40 mm projected grenades. Aerosols, pellets and hand-held smoke generators are also used for training purposes.

Lachrymatory agents cause intense irritation on contact, especially when moisture is present; the effect is greatest on mucous membranes and particularly the eyes, where the tear ducts are over-stimulated to produce fluid. Although they are not intended to cause long-term disability, they can be dangerous or even fatal in high concentrations within a confined space.

BBC: Bromobenzylcyanide

BBC is a liquid lachrymatory agent with an odour like soured fruit; it causes intense irritation but is not toxic. Its effect is immediate, producing a burning sensation of the mucous membranes with severe irritation and lachrymation of the eyes; this is generally accompanied by acute pain in the forehead. The agent is relatively persistent, and large splashes of liquid may remain active for one to two days under normal weather conditions.

CN: Chloroacetophenone

CN is a liquid lachrymatory agent with an odour similar to apple blossom; it is irritating but not toxic unless encountered in high concentrations. It acts immediately to produce powerful lachrymatory effects and irritation to the upper respiratory passages. In high concentration, it is irritating to the skin and causes a burning and itching sensation, especially on moist parts of the body, where it may also cause blisters. The effects are similar to those of sunburn and are harmless; they normally disappear in a few hours. Some individuals may experience nausea following exposure to CN. The duration of effectiveness is short because the agent is disseminated as an aerosol.

For disposal, CN can be vented under favourable weather conditions, or neutralised using a solution of sodium hydroxide in alcohol.

CNB

CNB is an obsolete liquid lachrymatory agent consisting of a solution of CN (chloroacetophenone) in benzene and carbon tetrachloride; it was adopted in 1920 and remained in use until it was replaced by CNS. It has the characteristic odour of benzene and, dispensed in aerosol form, produces powerful lachrymatory effects for a relatively short duration. Although CN is non-toxic, benzene is known to be carcinogenic.

CNC

CNC is a liquid lachrymatory agent consisting of a solution of CN (chloroacetophenone) in chloroform. It has the characteristic odour of chloroform and acts immediately to produce a strong lachrymatory effect, irritation of the respiratory system and stinging of skin. Its duration of effectiveness is short (because the agent is disseminated as an aerosol) and it is considered non-toxic.

CNS

CNS is a liquid lachrymatory agent consisting of a mixture of CN (chloroacetophenone), chloropicrin and chloroform. It has an odour similar to flypaper and produces immediate effects, although its duration of effectiveness is short. In addition to the symptoms normally associated with lachrymatory agents, CNS acts as a vomiting and choking agent. It can cause lung effects similar to those of CG (phosgene) and may also cause nausea, vomiting, colic and diarrhoea. The effects are cumulative and may continue for several weeks. Since such serious and prolonged effects are unacceptable for training and riot control, CNS is now rarely used.

CS: O-Chlorobenzalmalononitrile

CS (O-chlorobenzalmalononitrile) is a white crystalline lachrymatory agent with a peppery odour. It is normally dispersed from pyrotechnic generators or riot grenades as a smoke and, although it produces intense irritation, it is non-toxic. Effects include extreme burning of the eyes, accompanied by copious tears, coughing, difficulty in breathing and tightness of the chest. It also produces a stinging sensation on moist skin, running nose and dizziness; high concentrations can also cause nausea and vomiting. The onset of incapacitation is 20 to 60 seconds; the effects last 5 to 10 minutes after the affected individual is removed to fresh air. CS has now largely replaced CN (chloroacetophenone) and other tear agents as a riot control agent.

For disposal, CS can be vented under favourable weather conditions, or neutralised using a solution of sodium hydroxide in alcohol (see *Disposal options*).

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INCAPACITATING AGENTS

Incapacitating agents are defined as those substances that can cause incapacity when administered at one hundredth of the lethal dose; as this definition implies, most are lethal if encountered in sufficient concentrations. They are designed to produce physiological or mental effects which interfere with the victim's capacity to operate effectively. There are basically two types: those that produce temporary physical disability and those that produce temporary mental dysfunction. The most common physical incapacitating agents are DA, DC and DM (see separate entries), all of which cause vomiting. An agent known as BZ, first produced in the US, was designed to cause temporary mental dysfunction but has now been abandoned. The effects of incapacitating agents (detailed in the BZ entry) are reversible and complete recovery is usual.

BZ: Benactyzine

In the 1950s, the United States experimented with non-lethal agents that were designed to cause temporary mental dysfunction of the opponent. However, trials revealed that BZ (benactyzine) and similar agents, such as Lysergic Acid Derivative (LSD), were both unpredictable and unreliable. BZ was incorporated into a number of weapon systems, including cluster bombs, but it has now been withdrawn from use with US forces and all stocks have been destroyed. BZ, or similar agents, may still be in service elsewhere for use by special forces involved in hostage or counter-terrorist situations.

BZ is a crystalline solid at normal temperatures and is sufficiently stable to be disseminated as smoke from a pyrotechnic device. Once in the body, BZ acts as an incapacitating agent by blocking the activity of cholinergic synapses in a manner similar to that of atropine. Symptoms include dry, flushed skin, tachycardia (raised heart rate), urinary retention, constipation, slowing of mental and physical activity, headache, giddiness, disorientation, delusions, hallucinations, drowsiness, sometimes maniacal behaviour and an increase in body temperature. The symptoms can vary widely from person to person and may last for several days.

BZ can be neutralised using a solution of sodium hydroxide in alcohol (see *Disposal options*).

VOMITING AGENTS

Vomiting agents are categorised as incapacitating agents, and are employed because they produce physiological effects that interfere with the victim's capacity to operate effectively. They are normally solid at room temperature, but vaporise when heated and then condense to form aerosols. Under field conditions, vomiting agents cause great discomfort, but they are not normally toxic; however, when encountered in enclosed spaces, the high concentrations can cause serious illness or death. During the First World War, vomiting agents were sometimes combined with other more lethal agents, with the intent that vomiting would force soldiers to remove their gas masks.

DA: Diphenylchloroarsine

The liquid vomiting agent DA (diphenylchloroarsine) is irritating but not toxic, and has no pronounced odour. It acts quickly (within 2 or 3 minutes) and the effects normally last about 30 minutes after the victim leaves the contaminated atmosphere. The effects of high concentrations can, however, last several hours. Symptoms begin with irritation of the eyes and mucous membranes, running nose, sneezing and coughing; these are followed by severe headache, acute pain and tightness in the chest, nausea and vomiting. Since the agent is disseminated as an aerosol, duration of effectiveness is short and the disposal of small quantities by venting or incineration is possible under favourable weather conditions (see *Disposal options*)

DC: Diphenylcyanoarsine

The liquid vomiting agent DC is irritating but non-toxic and has an odour similar to a mixture of garlic and bitter almonds. It acts very rapidly, with high concentrations becoming intolerable after about 30 seconds. Symptoms are similar to those produced by DA (diphenylchloroarsine), but appear more quickly. The agent is disseminated as an aerosol and is therefore non-persistent; under favourable weather conditions small quantities can be disposed of by venting or incineration (see *Disposal options*).

DM: Adamsite

DM (diphenylaminochloroarsine or phenarsazine chloride), also known as 'adamsite', is a liquid agent with no pronounced odour. It is very fast-acting (it takes about 1 minute to produce temporary incapacitation) but is relatively non-toxic. The effects are similar to those produced by DA (diphenylchloroarsine) and typically last about 30 minutes after the victim leaves the contaminated atmosphere. At higher concentrations, the effects may last up to 3 hours. The agent is disseminated as an aerosol; it is therefore non-persistent and small quantities can be disposed of by venting or incineration under favourable weather conditions (see *Disposal options*).

Training Agents

Training agents are non-toxic compounds used to stimulate chemical agents during exercises, or for the development and testing of chemical weapons.

MR: Molasses Residuum (Simulated Mustard)

Molasses residuum (MR) is not a chemical agent but a harmless compound used as a substitute for mustard agent during training and for the testing of chemical weapons. It was developed after the First World War, and has been used as a simulant for distilled mustard (HD) since 1937; it may, therefore, be found in munitions remaining in old training areas or experimental establishments. The solution is made by dissolving 25 per cent (by volume) of molasses residuum in water, which forms a dark brown liquid of thin, syrupy consistency. Although it has a lower specific gravity than either pure or crude mustard, the viscosity and surface tension are close to those of HD, giving it comparable flow characteristics. MR has the distinctive odour of molasses and is harmless unless swallowed.

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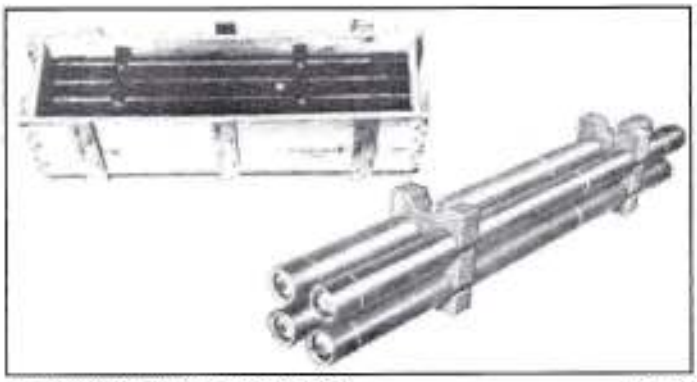
A British No. 2 Mk. 1 'Arched Demolition Charge' in Iraq (George Zahaczewsky) 1041024

An inert training version of the Russian KZ-3 point focal charge (Colin King) 1041025

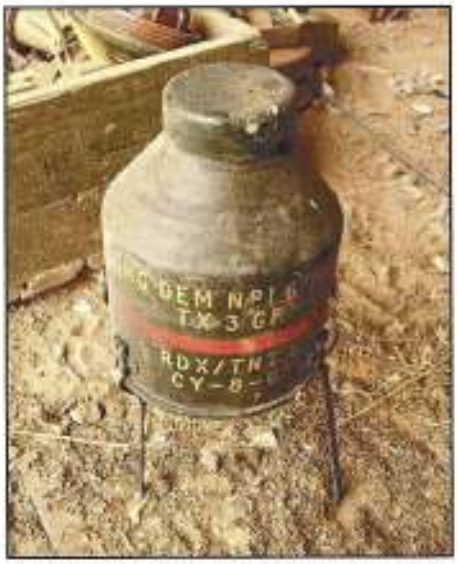


The Israeli No 21 Bangalore torpedo 0511677

British No. 3 Mk. 1 'Hayrick' linear cutting charges in Iraq (George Zahaczewsky) 1041023

The Russian KZ-4 cratering charge is substantially larger than the KZ-5 (Colin King) 1289956

Russian KZ-5 cratering charges. Note the TG-40 (RDX/TNT) fill designator (George Zahaczewsky) 1041022



A British 6 inch 'Beehive' cratering charge (George Zahaczewsky) 1342184

DEMOLITION CHARGES

Description

Demolition charges basically consist of bulk HE in a container and may be general-purpose or designed for a specific role. The casing may incorporate joining or attachment mechanisms, such as brackets, clamps and magnets, and may also have multiple fuze wells capable of accepting initiators and delay devices. Unlike limpet mines, demolition charges do not incorporate fuzes or initiation mechanisms of any kind.

General-purpose demolition charges are normally in the form of cylindrical or rectangular blocks of explosive encased in cardboard, sheet metal or plastic; they tend to be featureless, other than a single detonator well.

Bangalore torpedos are explosive-filled tubes, normally used to clear obstacles such as barbed wire or small mined areas. Most use rigid metal tubes, but some flexible types are also made; they are generally supplied in sets with initiators and coupling devices, enabling them to be joined into one long charge. A pointed front section or skid system allows them to be pushed along the ground as they are assembled.

Shaped charges are normally encased in sheet metal. The most common are cratering charges with conical liners and cylindrical or beehive-shaped bodies, which are often fitted with legs to create adequate stand-off. Linear cutting charges tend to have rectangular or prism-shaped flexible casings and often sacrifice stand-off for compact packaging and ease of handling. These are generally used to cut steel girders, but are also effective against reinforced concrete beams and slabs. There are also arched linear charges and annular charges, such as the Russian KZK, designed to cut cables and bars.

Cratering charges are often used in two-stage attacks, where the resulting hole is filled with explosive to produce an effective crater. The British Rapid Cratering Kit (RCK) was designed to provide the necessary components in a single portable unit, but requires two separate approaches and firings. However, some systems, such as the Russian KFZ-1 cratering munition and the OZ-1 foxhole munition, incorporate a two-stage attack into a single assembly requiring only one approach and firing. A small shaped charge is used to create a hole, into which a rocket-propelled cratering charge is fired, automatically, within a fraction of a second.

Operational details

Typical operation

Demolition charges can be used alone, or linked together in a ring main or main line demolition system. Linear cutting charges often have brackets that allow them to be joined to create a longer cut or form a ring around a target (such as a large bridge girder). Most charges incorporate a booster below the fuze or detonating well to ensure successful initiation. On detonation, shaped charges use the Munroe effect to project a high-velocity jet or sheet of molten metal through the target. Bulk explosive and shaped charges may be combined for two-stage attacks on targets such as reinforced concrete bridge decks; here, the bulk explosive shatters and strips the concrete to expose the steel reinforcement, which is then cut using the shaped charges. When demolition charges are used for sabotage, they are likely to be fitted with a delay or remotely controlled initiator.

EOD considerations

- Multiple charges may be connected by detonating cord
- Shaped charges have a substantial danger distance
- Once armed, delay initiators are unlikely to indicate the time remaining
- Systems such as the KFZ-1 and OZ-1 incorporate a shaped charge, rocket motor and cratering charge.

Specifications

Type	**Point focal**	**Linear cutting**	**Bangalore torpedo**	**Annular**
Example	**Russian KZ-5**	**British Hayrick No 3 Mk 1**	**Israeli No 21 (each section)**	**Russian KZK**
Body diameter/width:	215 mm	152 mm	57 mm	200 mm
Height:	280 mm	445 mm	n/a	52 mm
Length:	n/a	292 mm	1.1 m	n/a
Weight:	12.5 kg	12.5 kg	4 kg	1 kg
Explosive weight:	8.5 kg	6.8 kg	3.3 kg	0.4 kg
Penetration:	450 mm steel 1.4 m reinforced concrete	300 mm steel (est) 1 m reinforced concrete (est)	triple concertina barbed wire	70 mm steel rod 65 mm wire rope

Notes

Once disarmed, demolition charges are normally relatively safe to handle.

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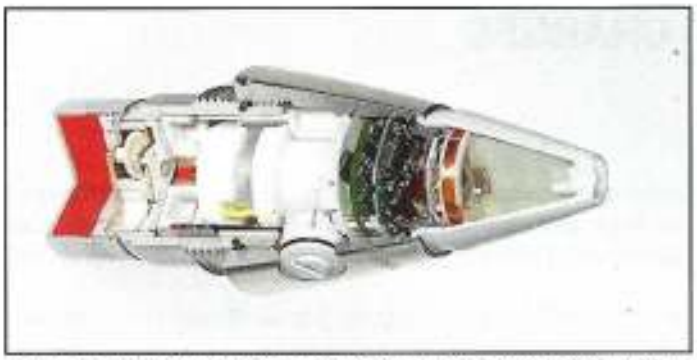

DM 74 is a multi-function fuze with proximity, PD (delay or SQ) and long delay options. 0064351

The Russian AM-A is among the simplest impact bomb fuzes. When used with the AO-1SCh bomblet, the arming vane is absent (Colin King) 1310635

The British No 79 'pistol' incorporates a chemical long delay (Colin King) 1374679

The Russian M-6 mortar fuze (Colin King) 1310645

A unexploded Mk 82 bomb with an armed FMU-139 fuze in Iraq (Colin King) 1310791

FUZES

FUZES – GENERAL

Description

A fuze is the component of a munition designed to cause initiation at the correct time, or when the appropriate conditions are met. This mechanism or system should not be confused with a fuse (spelled with an 's' instead of a 'z'), which is merely a simple pyrotechnic delay. Another term, formerly used by the British, is 'pistol', which refers to a fuzing mechanism with no explosive content. In addition to ensuring that the munition functions under the correct circumstances, the fuze is also responsible for preventing premature initiation and will usually, therefore, incorporate a number of safety features. Although there are many different types of fuze, they can be divided into categories according to their operating principles.

The most common fuzes are designed to function on impact. In projectiles, mortar bombs and rockets, they tend to be mounted in the nose of the munition and are termed 'Point Detonating' (PD). They may incorporate a short delay or function instantly, when they are sometimes called 'SuperQuick' (SQ). For High Explosive Anti-Tank (HEAT) charges requiring initiation from the base, the fuze (located behind the charge) may be actuated by an element in the nose; this is termed Point Initiating, Base Detonating (PIBD). Some types of ammunition, such as Armour Piercing (AP) and High Explosive Squash Head (HESH) cannot use a nose fuze, so Base Detonating (BD) fuzes are also in use. Impact fuzes often incorporate an optional short delay, typically in the region of 50 milliseconds.

Longer delays, in the order of seconds or minutes, are used in applications such as air-burst projectiles and cluster bombs, or ammunition designed to function some time after impact. Some delay fuzes also incorporate an impact function; these are known as Time and SuperQuick (TSQ) or Mechanical Time and SuperQuick (MTSQ). Delay fuzes in which internal channels are filled with a slow-burning pyrotechnic composition are sometimes called 'Powder Train Time' (PTT) fuzes.

The use of early proximity fuzes was confined to aircraft bombs and large missiles due to their size. However, electronic proximity fuzes are now small enough to use on projectiles, mortar bombs and rockets, where they have replaced delay fuzes in some applications, such as air-burst.

With the advent of miniaturised electronics, it has become possible to incorporate a number of functions into a single fuze, allowing the user to select options such as impact, short delay, proximity, long delay and self destruct. The fuze may even be capable of defaulting from one function to another in case of partial failure or change of circumstance. Pyrotechnic and clockwork delays are steadily being replaced by Electronic Time (ET) fuzes.

Fuzes tend to have standard threads (such as the 2 inch 12NS-1A used in many NATO projectiles) and protrude into the fuze well to a given depth, allowing them to be used with a range of ammunition.

Operational details

Typical operation

Most bomb and projectile fuzes incorporate an arming sequence that is activated as the munition is fired or dropped. In bomb fuzes, this usually involves a time delay, such as a wind-driven vane unwinding a screw thread. In projectile fuzes, the forces of firing ('set-back' and spin) tend to be used to remove locking components or 'detents' and slide or rotate elements of the firing train (often incorporated into a 'shutter') into line. Firing may also initiate a Self-Destruct (SD) feature.

PD fuzes often function with a pin being driven into a stab-receptor, once all the components are aligned; the resultant flash being channelled directly to the detonator for SQ function, or diverted by a 'masking shutter' via a short pyrotechnic element to create a delay.

PIBD fuzes are usually initiated by a nose-mounted piezoelectric element, but a few types have a separate impact nose fuze which 'spits back' into a flash receptor in the base fuze.

Delay fuzes tend to be mechanical (using clockwork), pyrotechnic or electrical/electronic. Some older fuzes also used chemical delays in which, for example, a glass ampoule of acetone would dissolve a celluloid disc retaining a striker.

Electronic mortar and projectile fuzes often use 'reserve batteries' (in which the liquid electrolyte is separated from the cell until activation) or air-driven turbines. Electronic bomb fuzes may be charged by the aircraft before release.

EOD considerations

Many fuzes look similar, making correct identification difficult; fuzes may be covered by protective ballistic caps that further hinder recognition; some fuzes incorporate large booster charges; partially impacted fuzes may be in a sensitive condition; multi-function fuzes may incorporate proximity, SD or anti-disturbance features; being 'kicked out' from a demolition might cause a fuze to arm; some tracer elements are easily confused with base fuzes.

Typical specifications

Example	Mortar Fuze	Projectile fuze	Bomb fuze
Type:	Russian M-6	South African M841A1	US FMU-139 (nose or tail)
Operation:	Mechanical impact	Mechanical impact/short delay	Electronic impact/short delay
Typical application:	82 mm HE	155 mm HE	Mk 81, 82 and 83
Length:	83 mm	154 mm	174 mm
Diameter:	40 mm	61 mm	73 mm

Notes

For more detail, see separate entries in the *Fuzes* section. Some fuze information is also included in records relating to specific munition types.

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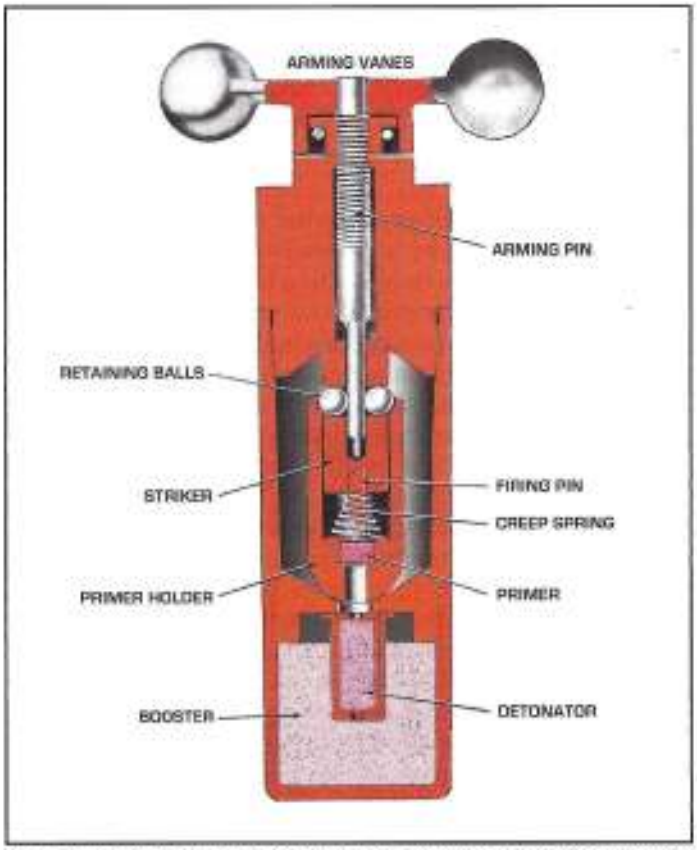
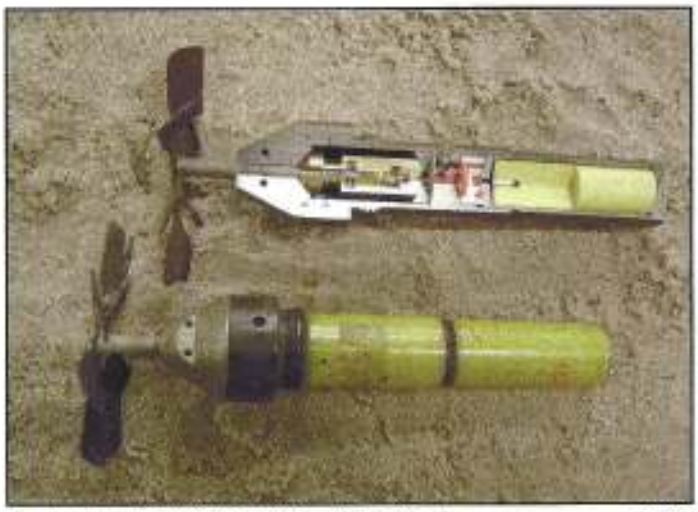
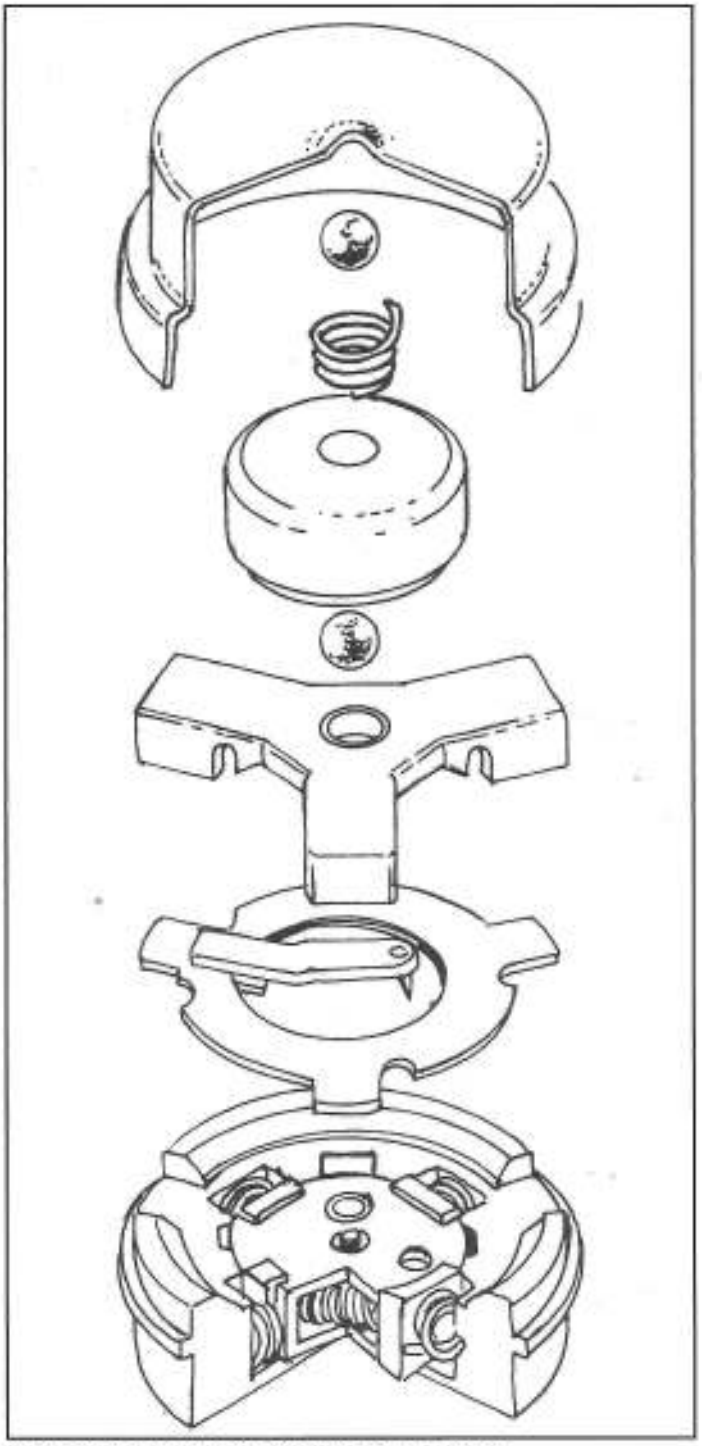


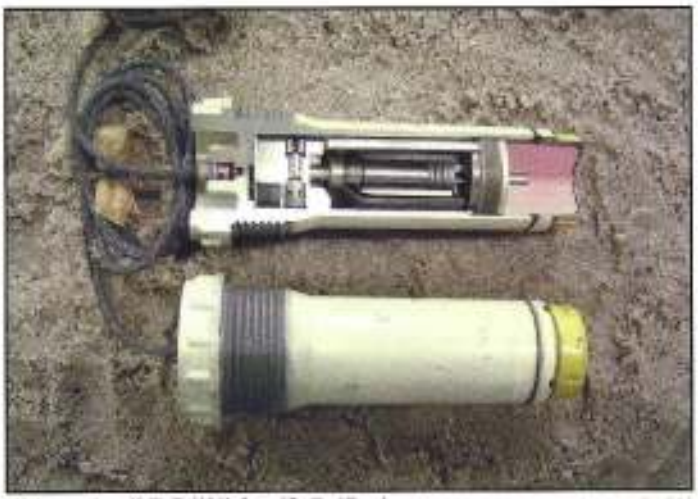
A sectioned diagram of the US M173 fuze, showing the AWA mechanism (Colin King) 1310644



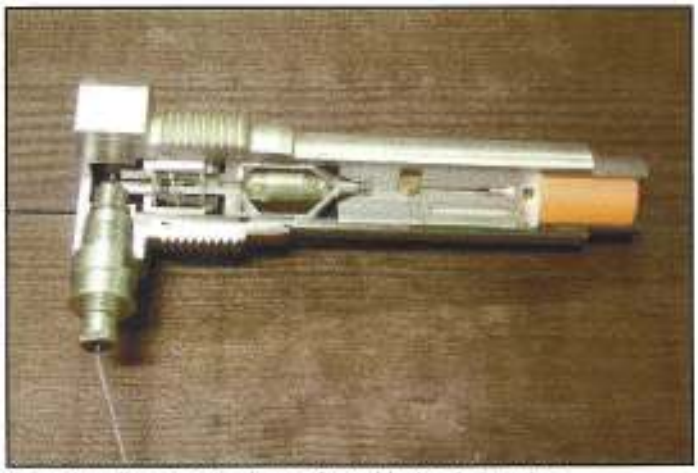
An obsolete British AWA bomb fuze (Colin King) 1310634



Components of the M219E1 fuze used in the BLU-61/B (Lyn Haywood) 0074132



The Russian AVB-E AWA fuze (Colin King) 1311060



A Russian all-ways acting impact fuze with electrical arming (Colin King) 1341063

ALL-WAYS ACTING FUZES

Description

All-Ways Acting (AWA) fuzes, sometimes known as 'graze' fuzes, are generally used in munitions where the optimum impact angle cannot be guaranteed. Typical applications are in grenades, submunitions and bombs, such as napalm incendiary bombs without stabilising fins, which tumble when dropped. Although most are capable of functioning at any angle, some designs will not be initiated by an impact on the base, or in some other specific direction; these are known as 'semi-all-ways acting' fuzes. The use of these fuzes in bombs is now comparatively rare, but the US BLU-97 and Chilean PM-1 bomblets both incorporate AWA initiation mechanisms, as do most spin-armed submunitions and some hand grenades. In the case of the BLU-97, this is the main reason for this submunition causing so many post-conflict casualties. Fortunately, the AWA fuze in the PM-1 is heavily sprung, and therefore relatively insensitive.

Since the fuze will function in a range of orientations, its location within the munition is relatively unimportant. Thus AWA fuzes can be nose, tail of transversely mounted in bombs. In the BLU-97 and PM-1, the fuze is mounted behind the HEAT warhead, while the fuzes of most spin-armed submunitions are housed centrally.

AWA fuzes are particularly relevant to the EOD operator since, in effect, they can give an unexploded munition an anti-disturbance capability. The presence of an AWA fuze means that movement and shock must be avoided during EOD action, often dictating that the ordnance must be demolished in-place.

Operational details

Typical operation

Most AWA fuzes use a firing pin and stab receptor, separated by a creep spring or simple captive system. These components are held in a telescopic 'primer holder' or carrier assembly which, in turn, is housed in a cavity with tapered ends. The components will normally be secured by an arming mechanism, such as retaining balls held in place by a vane-driven spindle, until the munition has been deployed. As the vanes are rotated in the air stream, the spindle is unscrewed to allow the retaining balls to move inwards, disengaging from the walls of the carrier. In the case of axial (nose or tail) impact, the inertia of the pin overcomes the creep spring, allowing it to be driven directly into the stab receptor, or vice versa. If the fuze experiences a side impact, the two sections of the carrier are forced together by the tapered ends of the cavity. There are a number of variations on this theme, but most rely on tapered cavities or sloping surfaces to translate side impact into axial motion. Another type of mechanism uses a ball bearing housed in a dished retainer; side impact results in the ball moving towards the raised edge of the dish, thereby creating a force on the dished assembly at right angles to the movement of the ball. The flash from the stab receptor is channelled into a detonator and booster, housed within the body of the fuze.

EOD considerations

- It is vital to establish the presence of an AWA fuze
- Establishing the condition of an AWA fuze requires detailed and specific information
- If in doubt, always assume that the fuze is fully armed
- AWA fuzes may be initiated by sudden movement or shock
- Violent EOD techniques (such as rocket wrenches) should not be used with AWA fuzes
- Munitions in unstable locations, such as on sloping ground, should be secured
- Where possible, munitions with AWA fuzes should be destroyed in-place.

Typical specifications

Example	US M173	Russian AVB-E	US M219E1
Type:	Nose/tail bomb fuze	Nose/tail bomb fuze	Spin-armed bomblet
Application:	Incendiary bombs	HE bombs	BLU-61/B bomblet
Length:	106 mm	140 mm	20 mm (est)
Diameter:	50 mm	60 mm	35 mm (est)

Notes

Details of the BLU-97, BLU-61/B and PM-1 bomblets are given in separate entries in the *Submunitions* section. See also *Incendiary bombs, Impact fragmentation hand grenades* and *Spin-stabilised grenades.*

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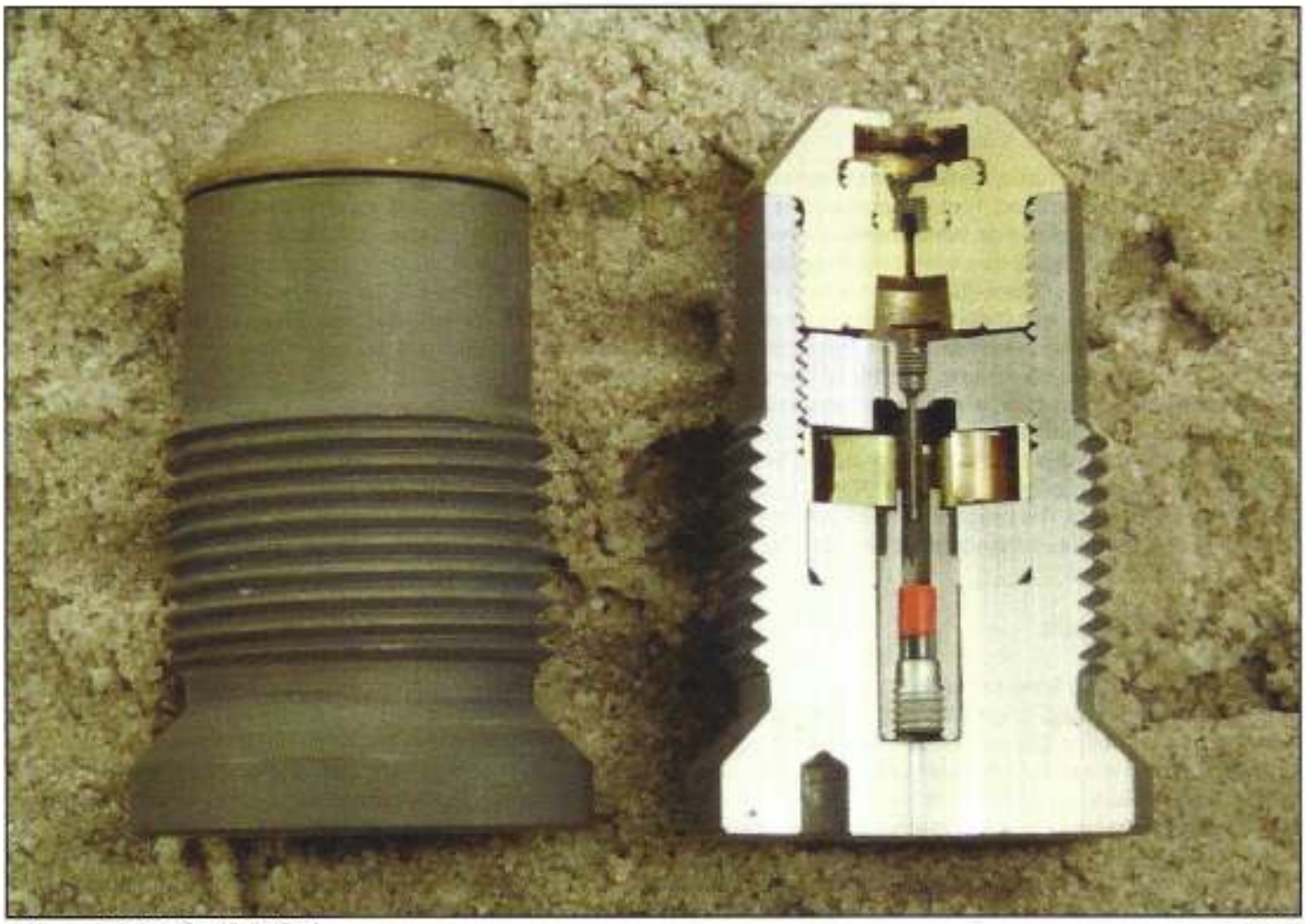
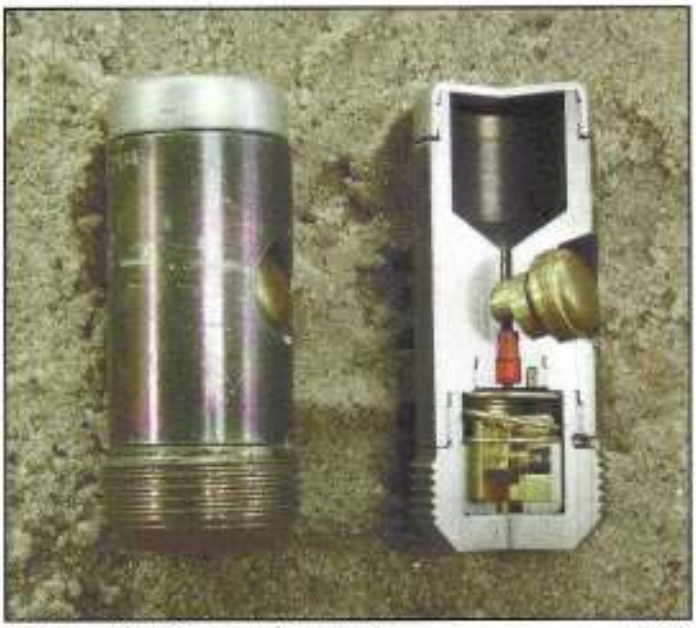
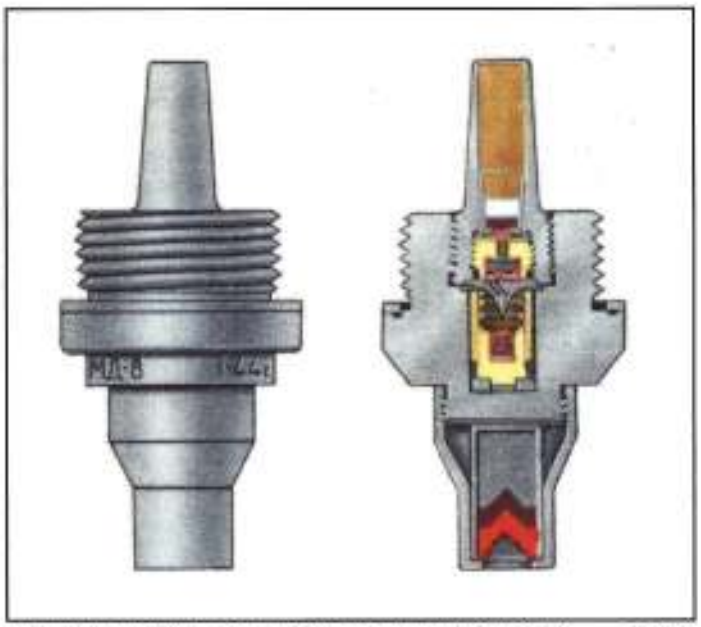


A German Bdz C438 fuze (Colin King) 1310638



A Belgian NR-2143 base fuze (Colin King) 1310633



The Russian MD-8 base fuze, with tracer element (Colin King) 1310649

BASE DETONATING FUZES

Description

Base Detonating (BD) fuzes are mainly used in Armour-Piercing (AP) and High Explosive Squash Head (HESH) projectiles. They are also found in some bursting White Phosphorus (WP) rounds and simple High Explosive Anti-Tank (HEAT) warheads, such as the Russian PG-2 RPG round (see separate entry; *RPG fuzes*). Base fuzes are generally used in AP projectiles in order to allow the fuze to survive the impact; the nose of the projectile can then be made from a thick layer of hard steel. In a HESH projectile, the tip of the nose is filled with an inert wax and the explosive, encased by the shell body, is designed to deform against the armour of the target. In addition to preventing the use of a nose fuze, the HESH charge must be initiated from the rear in order to propagate the detonation shockwave into the target. BD fuzes for use in direct fire projectiles, such as tank ammunition, are often fitted with tracer elements; some also incorporate a Self-Destruct (SD) delay. The firing forces of set-back and spin are generally used to arm BD fuzes. BD fuzes often have left-hand threads to avoid the risk of unscrewing when the projectile spins.

Operational details

Typical operation

On firing, the pyrotechnic tracer element is ignited by the propellant charge. When the projectile achieves a sufficient spin rate, centrifugal force is used (sometimes in conjunction with the force of set-back) to withdraw locking pins or 'detents', allowing the detonator rotor to move into line with the firing pin. An additional safety feature may consist of a block that moves aside, or a shutter that moves into line, containing a charge to link the detonator to the booster. On impact, the inertia of the striker overcomes a creep spring to drive the firing pin into the stab-sensitive detonator. BD fuzes often incorporate a very short delay to allow the projectile to enter, or squash onto, the target before detonating. In some designs, the firer can select delay or instantaneous functions. When delay is selected, a masking shutter diverts the flash into a pyrotechnic composition, which burns away before initiating the detonator. The inertia of firing may also be used to ignite a pyrotechnic SD delay, which will detonate the main charge if the primary fuze function fails. Early fuzes, such as the Russian MD-8, have no safety or arming features. This fuze simply uses the inertia of a carrier holding the stab receptor to overcome a creep spring and strike the fixed firing pin.

EOD considerations

- It is sometimes difficult to distinguish between a BD fuze in a HE projectile and a tracer pocket in a solid shot
- In base-fuzed AP projectiles, the thick nose and side walls can make demolition difficult
- In HESH rounds, the casing is thinnest at the ogive and thicker towards the base of the projectile
- The base fuze used in a HEAT warhead, such as PG-2, is generally totally enclosed
- BD fuzes contain substantial HE boosters
- Many BD fuzes have a left-hand thread.

Typical specifications

Example	**Russian MD-8**	**Russian DK-4**	**US M91**
Application:	APHE projectiles	PG-2	HESH projectiles
Length:	63 mm	64 mm	104 mm
Diameter:	29 mm	29 mm	46 mm
Self destruct:	No	4.2 sec	No

Notes

HESH is known as High Explosive Plastic (HEP) in the US. For more information on AP and HESH projectiles, see separate entries in the *Projectiles* section.

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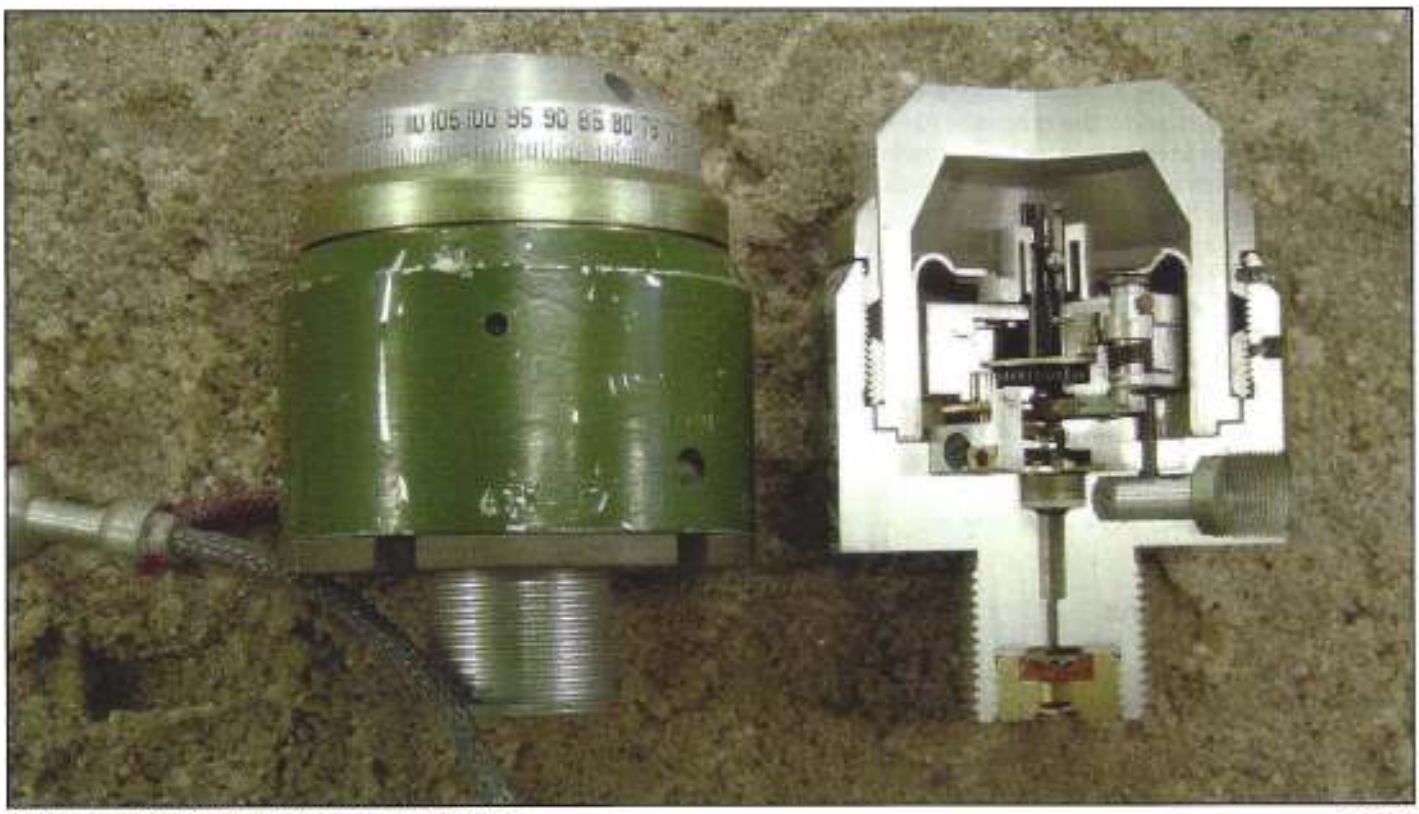
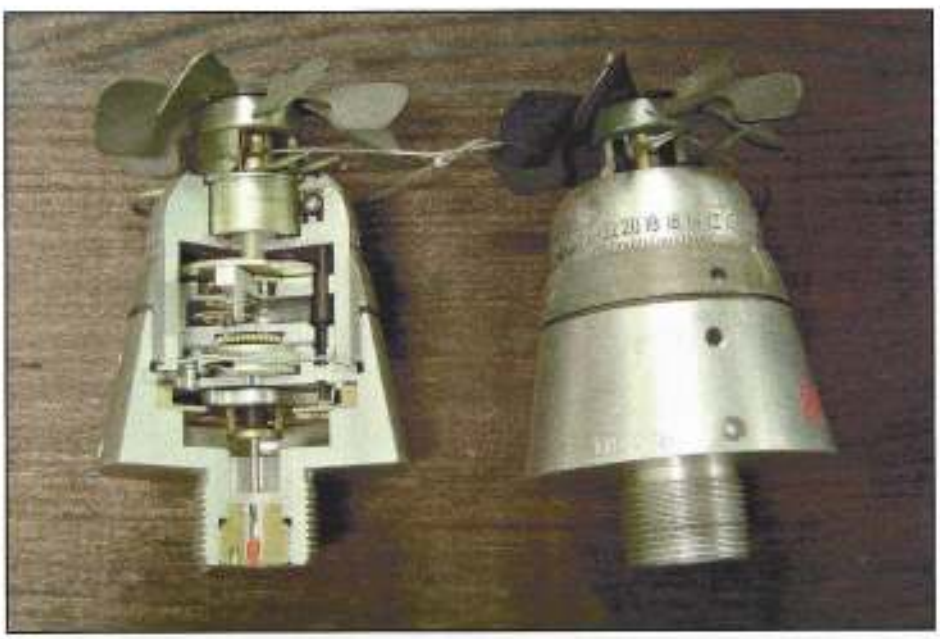
The Russian V-90 MT fuze (Colin King) 1310647

The US M582A1 MTSQ fuze. Note the window displaying the delay time and the setting screw in the nose
0008281



The Russian ATK-EB mechanical bomb fuze (Colin King) 1310637



The Russian TM-24B MT fuze is used primarily in airburst and concrete piercing (BETAB) bombs
(Colin King)
1341064

MECHANICAL DELAY FUZES

Description

MechanicalTime (MT) fuzes use clockwork mechanisms to allow relatively long delays (seconds rather than milliseconds). Typical applications are in HE airburst projectiles and bombs, carrier projectiles and cluster bombs. Clockwork mechanisms largely replaced the less accurate pyrotechnic delay fuzes, which are covered in a separate entry. MT fuzes are generally recognisable by the graduated markings used to indicate the delay setting. In some cases, such as the Russian V-90, these marks are covered by a ballistic cap, while some fuzes, such as the US M577 and M582 series, have a window in the side of the casing through which dials or timing wheels are visible. A ballistic cap can hinder recognition, however, the fuze designation is stamped onto the lower section of the body, which is exposed even if the cap is fitted. The time is set by rotating a key or slotted plug, or by rotating a section of the fuze body (as with the Russian ATK-EB). Slotted plugs can generally be moved using a screwdriver or coin, but purpose-built fuze setting tools are also available. MT fuzes are often combined with an instantaneous 'Point Detonating' (PD) function to make them more versatile; these are known as MechanicalTime and SuperQuick (MTSQ). MT fuzes are gradually being replaced by ElectronicTime (ET) fuzes and multi-function electronic fuzes.

Operational details

Typical operation

The fuze is set to the desired delay, or to the SQ function. On firing, set-back and spin forces are used to remove locking pins or 'detents' and slide or rotate components of the firing train into line. Bomb fuzes may use rotating vanes or an electrical pulse for arming. Detents are also moved to release the escapement of the clockwork mechanism so that the delay begins, power generally being provided by a coiled leaf spring. When the delay expires, a spring-loaded striker is released to force a firing pin into a stab receptor; the resultant flash is used to detonate a booster and main charge in an HE projectile or bomb, or fire a propellant expelling charge in a carrier munition. If the SQ function has been selected, the clockwork mechanism is disabled and a simple impact or inertia mechanism causes initiation.

EOD considerations

- MT fuzes contain intricate mechanisms which are prone to failure if damaged or deteriorated
- A clockwork mechanism may stop close to the point of initiation
- Movement, vibration or shock may restart a clockwork mechanism
- MT fuzes are often monitored using an electronic stethoscope during EOD operations
- Some fuzes contain substantial HE booster charges
- Some MTSQ fuzes will not function if they impact before the delay setting expires
- Some MT fuzes can be neutralised by seizing the mechanism using slurries or gels
- Some mechanisms with ferrous components can be seized using powerful magnets.

Typical specifications

Example	Russian ATK-EB	Russian V-90	US M582A1
Type	MT bomb fuze	MTSQ projectile fuze	MTSQ projectile fuze
Typical applications:	RBK cluster bombs and ZAB incendiary bombs	122, 130 and 152 mm HE/frag artillery projectiles	105, 155 and 203 mm HE and carrier projectiles
Overall length:	86 mm	108 mm	152 mm
Exposed length:	67 mm	61 mm	96 mm
Diameter:	64 mm	41 mm	61 mm

Notes

For more details of carrier projectiles and cluster bombs, see separate entries in the *Projectiles* and *Bombs* sections. See also *Pyrotechnic delay fuzes*.

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The US M48A3 (Colin King) 1310642

The Russian M-12, also produced by China (Colin King) 1310641

The US M524A6 mortar fuze (Colin King) 1311173

POINT DETONATING FUZES

Description

Point detonating (PD) is the term used for impact or 'percussion' fuzes fitted to, and initiating from, the nose of a projectile or mortar bomb. Other terms describing PD fuze types include Direct Action, Delayed Action and Graze Sensitive. The majority of the fuzes in service are mechanical and incorporate safety and arming systems to ensure that they do not function before or during firing. Most are basically conical and have relatively featureless metal bodies; they can therefore be distinguished from proximity fuzes, which tend to have plastic noses or bands, and time fuzes, which are normally marked with figures or graduations. PD fuzes generally contain a striker, mounted in or near the nose, separated from a stab receptor by a safety and arming mechanism. Some also have an external safety device, such as a cap, pin or clip, for additional protection during transit. Most have the option to function instantly on impact, known as 'SuperQuick' (SQ) or detonate after a short delay, typically in the region of 50 milliseconds. The SQ or delay option is normally selected by the user by turning a slotted screw in the side of the fuze body through 90°, between clearly marked settings; the presence of these markings ('SQ' and 'DELAY', or similar) is another indication of an impact fuze. The delay allows the projectile to penetrate its target before detonating. More complex fuzes may incorporate additional features, such as an arming delay and self-destruct mechanism. The base of the fuze, within or behind the threaded section of the body, normally contains a substantial explosive booster. Increasingly, mechanical fuzes are being replaced by multi-function electronic fuzes.

Operational details

Typical operation

The user selects the SQ or delay option, if available, and removes any external safety feature. Turning the selector to delay blocks the direct path of the flash between the stab receptor and detonator, diverting it through a small pyrotechnic relay. On firing, set-back and centrifugal forces from spin are used to remove internal blocks or 'detents', removing blockages from the flash channels and allowing components of the explosive train to move into line. In most mortar bomb fuzes, which do not experience spin when fired, set-back alone must initiate the safety and arming sequence. Set-back may also be used to fire an initiator, which can be used to ignite pyrotechnic arming pellets and self-destruct delays. Many of the more complex fuze mechanisms use a rotor to bring the detonator into line; once released by the firing forces, the rotor may be controlled by a gear train mechanism to impose an arming delay; this ensures that the projectile reaches a safe distance before becoming fully armed. When the rotor reaches the armed position, it is generally locked in place by a spring-loaded pin. On impact, the firing pin is driven into the stab receptor, with the resultant flash either channelled directly to the detonator, or via the delay element. Another system, as in the case of the US M48A3, is for a secondary initiator with in-built delay, to function on inertia; this has the advantage of acting as a back-up for the SQ option.

EOD considerations

- Nose fuzes are often badly damaged on impact, making recognition difficult
- It is often impossible to establish whether or not a fuze is armed from its external appearance
- Partially impacted fuzes may be in a sensitive condition
- Fuzes may contain substantial HE booster charges
- Being 'kicked out' of a demolition may cause a fuze to arm.

Typical specifications

Example	Russian M-12	US M48	US M524A6
Type:	SQ/delay	SQ/delay	SQ/delay
Typical applications:	82 and 120 mm HE and WP mortar bombs	Projectiles, 75–203 mm	81 mm HE and WP mortar bombs
Overall length:	118 mm	117 mm	153 mm
Exposed length:	74 mm	95 mm	97 mm
Diameter:	50 mm	61 mm	60 mm (est)

Notes

Bombs and submunitions may also use impact nose fuzes, but these are not normally referred to as Point Detonating. For more information about HE projectiles and mortars, see separate entries.

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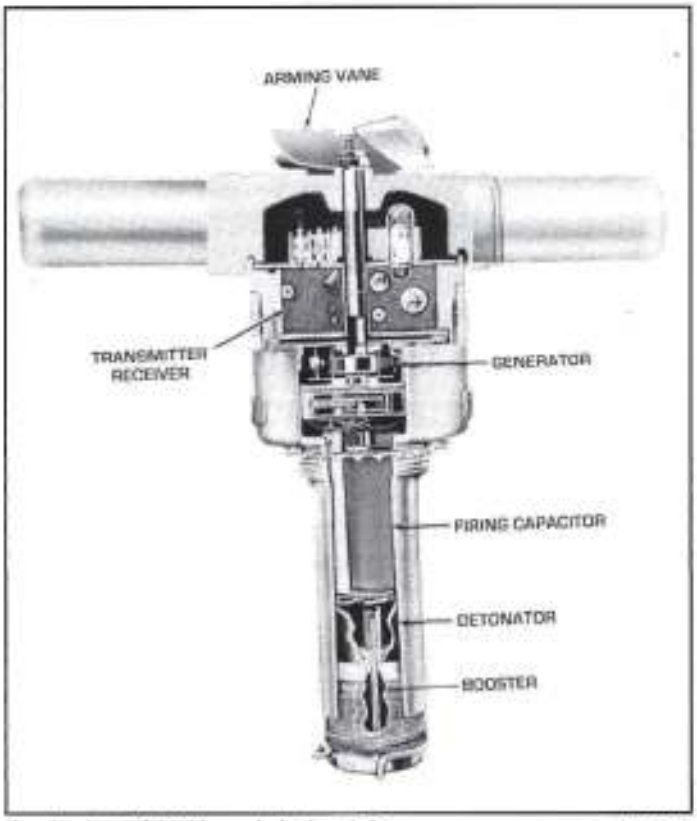
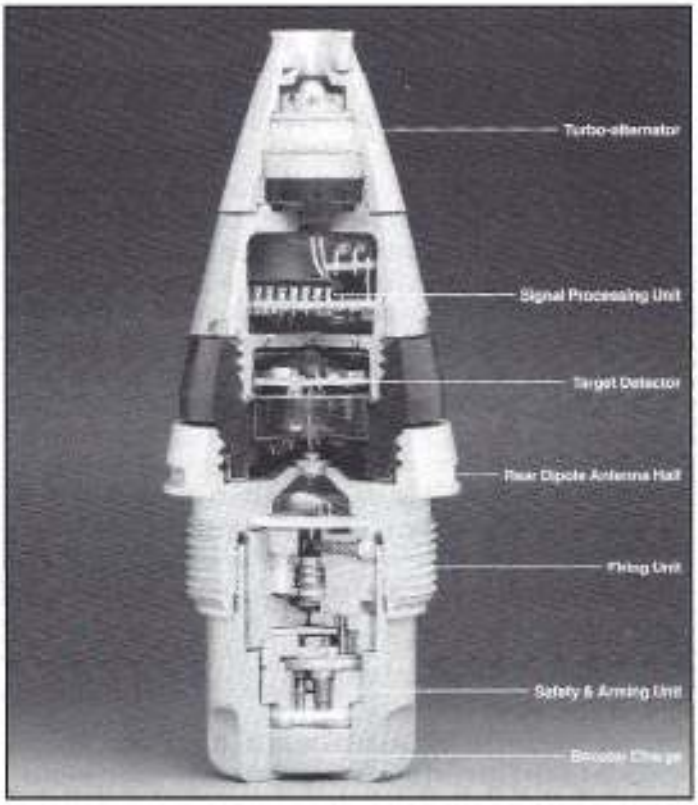
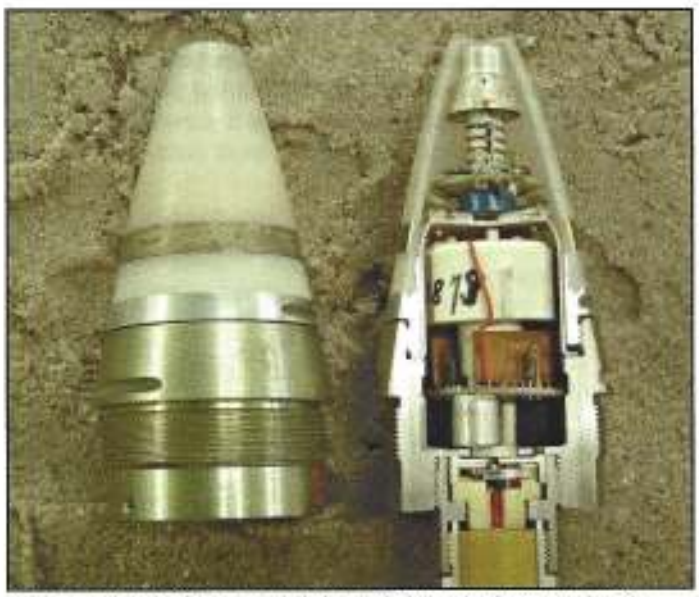


An obsolete US M166 proximity bomb fuze 1310639



A cutaway of the Norwegian PPD 440 multi-role fuze, now produced in Spain. Note the air-driven generator in the nose 0502462



Modern proximity fuzes normally have obvious plastic caps or bands (Colin King) 1374912

Cutaway of a modern proximity fuze. Note the glass ampoule of electrolyte for the 'reserve battery' (Colin King) 1310643

South African M8953 proximity fuze and programmer 0502463

PROXIMITY FUZES

Description

Proximity fuzes are designed to cause initiation at a given distance from the ground or target; they allow far greater precision than a delay fuze and therefore optimise the performance of the warhead. Early designs, sometimes known as Variable Time (VT) fuzes, were only suitable for bombs and large missiles as they were too big to fit to other types of ordnance. However, modern versions are also used on projectiles, mortars and rockets. Proximity fuzes use electronics to generate, receive and analyse a radar signal, and therefore require a power source. Air-driven generators and 'reserve batteries' (in which the liquid electrolyte is separated from the cell until activated) are generally used to provide short-duration power, but conventional batteries may also be used. Air-driven generators have the advantage of only providing sufficient energy to operate the fuze if they are travelling at high velocity, but electrolytic cells may provide power for some time after activation. Proximity fuzes are often recognisable by their plastic nose or rings, although a number of modern fuzes also incorporate other options, such as impact initiation. On some fuzes, setting options may be selected using features on the fuze, but several types now use a separate electronic programming unit. The programmer can also be used to interrogate fuzes in order to confirm their settings.

Operational details

Typical operation

The fuze function is set or programmed by the user for a burst height, typically between 0 and 15 m above ground. There may also be settings for sensitivity since heavy rain or snow, for example, might otherwise cause premature initiation. On firing, the glass ampoule in a 'reserve battery' is broken by set-back to release electrolyte into a cell, or an air-driven turbine begins turning to generate current. At the same time, spin and/or set-back are used to close electrical contacts within the circuit. The firing forces may also be used to remove blocks or 'detents' from the flash channels and slide or rotate elements of the firing train into line; these actions are similar to those used in Point detonating (PD) fuzes (see separate entry). A clockwork mechanism may be used to delay the movement of a rotor, allowing an arming delay before the detonator is brought into line with the igniter. In mortar bombs which do not experience spin, these arming actions are all initiated by set-back. When powered up and fully armed, the radar operates on the Doppler principle. A signal is transmitted to the front of the fuze; the reflection from the target is received and amplified, with analysis determining the distance and actuating an igniter at the appropriate point. Some multi-role fuzes have several igniters, each of which corresponds to one of the fuze roles. The igniter then initiates the detonator and booster in the base of the fuze.

EOD considerations

- Shock may break an ampoule to activate a liquid electrolyte cell
- Approaching an active proximity fuze may cause initiation
- Proximity fuzes should be approached from outside their (frontal) field of view
- Proximity fuzes may also incorporate impact and delay functions
- A 'soak time' should be allowed if EOD action might have activated a fuze
- Fuze boosters contain a substantial explosive charge
- Reserve batteries and firing capacitors may retain charge for some time after deployment.

Typical specifications

Example	Norwegian PPD 440	South African M8953	US M166
Type:	Dual-function; proximity or PD	Programmable proximity	Obsolete bomb fuze
Typical application:	NATO projectiles 105–203 mm	Naval anti-aircraft and anti-missile guns	GP bombs, including Mk 81, 82, 83 and 84
Overall length:	149 mm	203 mm	260 mm (est)
Exposed length:	93 mm	95 mm	127 mm
Diameter:	61 mm	61 mm	280 mm (est) across antennae

Notes

Some missiles incorporate optical proximity fuzes; a few early Russian designs used electrical sparks while most modern types use lasers.

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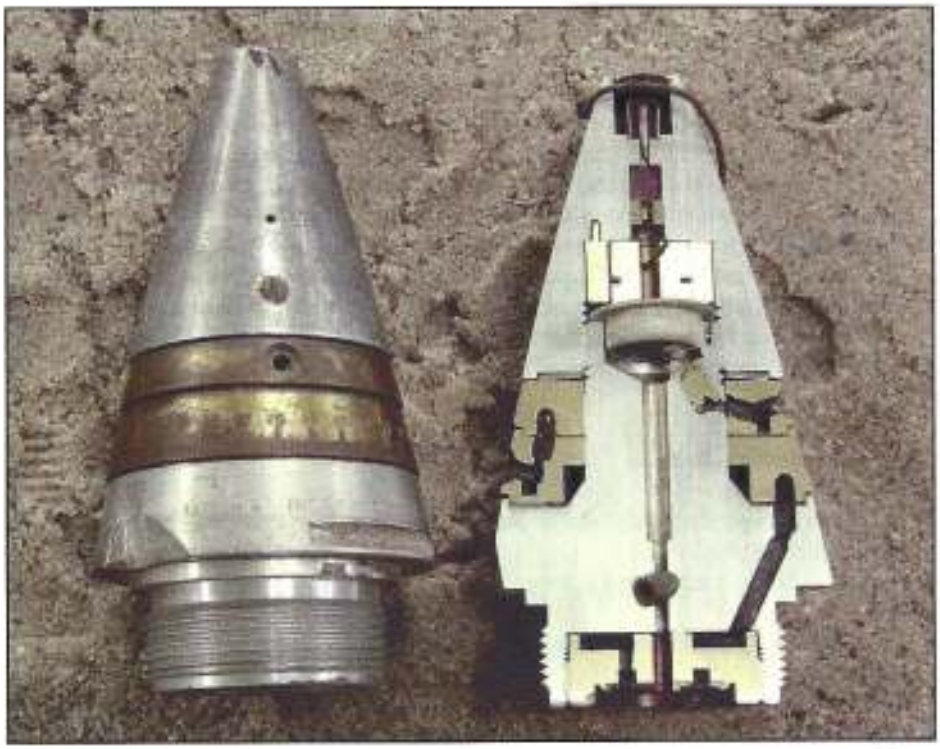
The Russian T-5; T-6 and T-7 are very similar designs. Note the ballistic cap fitted over the fuze (Colin King)
1310650



The US M54 (Colin King)
1310651

The Russian T-1 mortar fuze; note the staple joining the upper and lower rings. The D-1 is similar, but used in projectiles (Colin King) 1311264

The Russian D-1 fuze, with and without ballistic cap fitted 1374680

PYROTECHNIC DELAY FUZES

Description

Pyrotechnic delay fuzes, sometimes known as 'Powder Train Time' (PTT) fuzes, were used as an alternative to clockwork to provide long delays before the advent of compact Electronic Time (ET) fuzes. They are identified by the presence of multiple rings on their metallic bodies (sometimes made from brass), one of which will be marked with the delay settings. Unlike Mechanical Time (MT) and ET fuzes, they tend to have two or three rings containing the powder train; where three are used, the upper and lower rings may be joined together with a staple. Those intended for use in carrier munitions tend to have short threads containing a pyrotechnic output, while those for use in HE ordnance generally have a booster pocket protruding from the base beyond the threads. An external clip may be fitted to provide an additional safety feature during transit. Some designs combine PTT with an instantaneous impact option; these are known as 'Time and SuperQuick' (TSQ) and have a selector on the side of the fuze body. Russian fuzes are often fitted with a thin ballistic cap, which screws onto the fuze body to cover it. This can hinder recognition, however, the fuze designation is stamped onto the lower section of the body, which is exposed even if the cap is fitted.

Operational details

Typical operation

The user selects the required time delay by turning the rings to the appropriate mark; the safety clip, if fitted, is then removed. On firing, set-back acts on a firing pin, which overcomes a creep spring to strike a stab receptor. The resultant flash is directed into a circular channel of pyrotechnic composition (the 'powder train'), which burns at a controlled rate. The ring below has a window that allows the burn to pass into it, igniting the next circular powder train. A third ring may also be used. The alignment of the windows, set by rotating the rings, decides the overall length of the powder train and, therefore, the delay. At the end of the powder train, the flash is directed into the base of the fuze, where it either fires an igniter (to fire the ejection charge in a carrier munition) or initiates a detonator and booster (for HE ordnance). The detonator in a HE fuze will normally be housed in a rotor or slide, which will be brought into line during an arming process initiated by set-back and spin during firing. Where an SQ feature is available, as in the US M54, the selector opens a channel through the fuze. During impact, a firing pin is forced into a stab-sensitive detonator and the flash is channelled directly into the base of the fuze, bypassing the pyrotechnic delay.

EOD considerations

- Ballistic caps may hinder the recognition of Russian fuzes
- The fuze designation is visible on the section of the body immediately below the cap
- Some fuzes incorporate black powder charges or HE boosters
- Being 'kicked out' from a demolition may initiate a PTT fuze
- A 'soak time' should be allowed if EOD action may have subjected a fuze to shock or inertia.

Typical specifications

Example	**Russian T-5 and T-7**	**US M54**	**Russian T-1**
Type	PTT	TSQ	TSQ
Typical applications:	Projectiles: 76 and 85 mm (T-5); 122 and 152 mm (T-7)	75, 105, 155 and 203 mm projectiles	Carrier mortar bombs
Overall length:	157 mm	117 mm	71 mm
Exposed length:	128 mm	96 mm	60 mm
Diameter:	64 mm	60 mm	40 mm

Notes

See separate entries on *Carrier projectiles* and *Mortars*.

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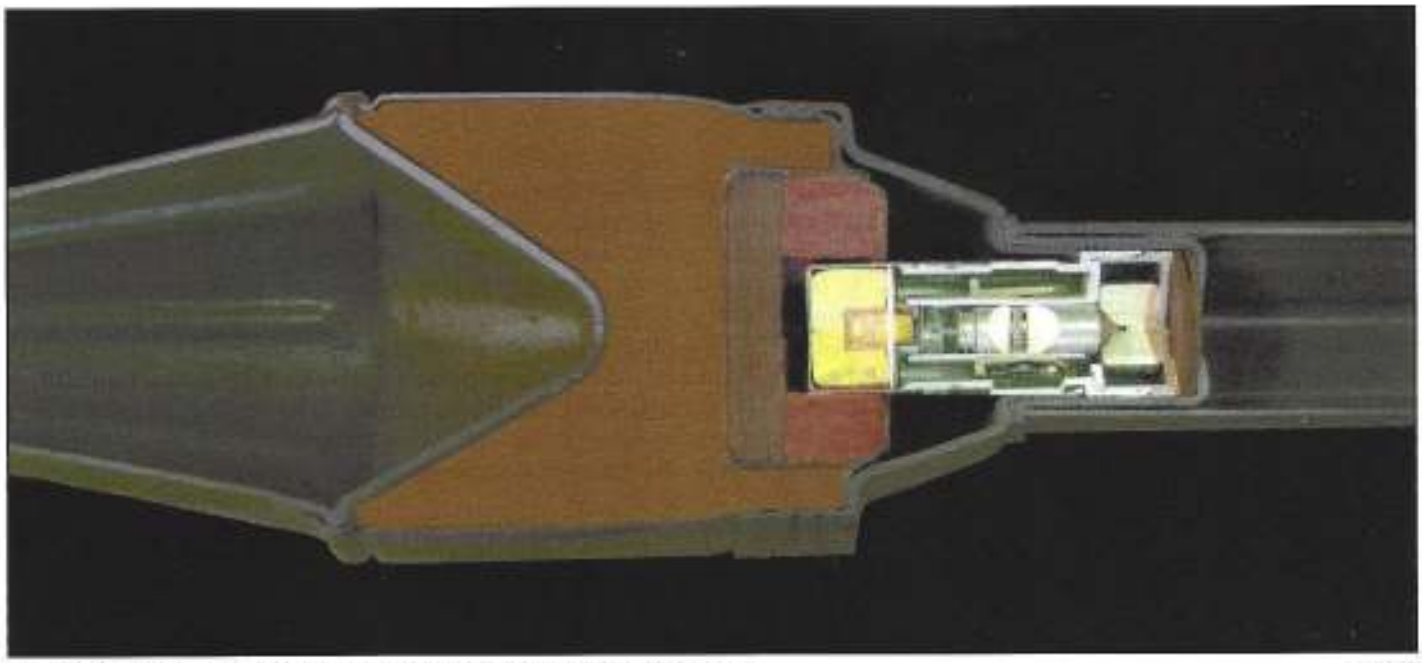
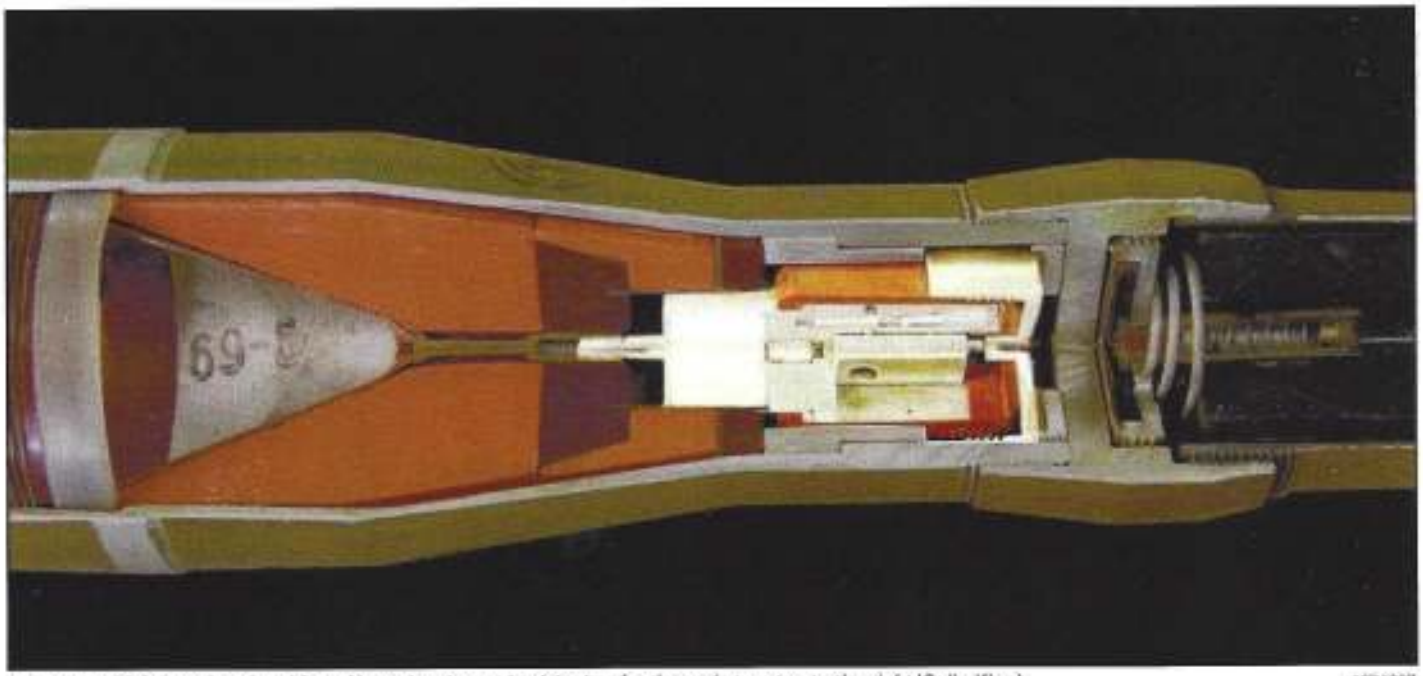
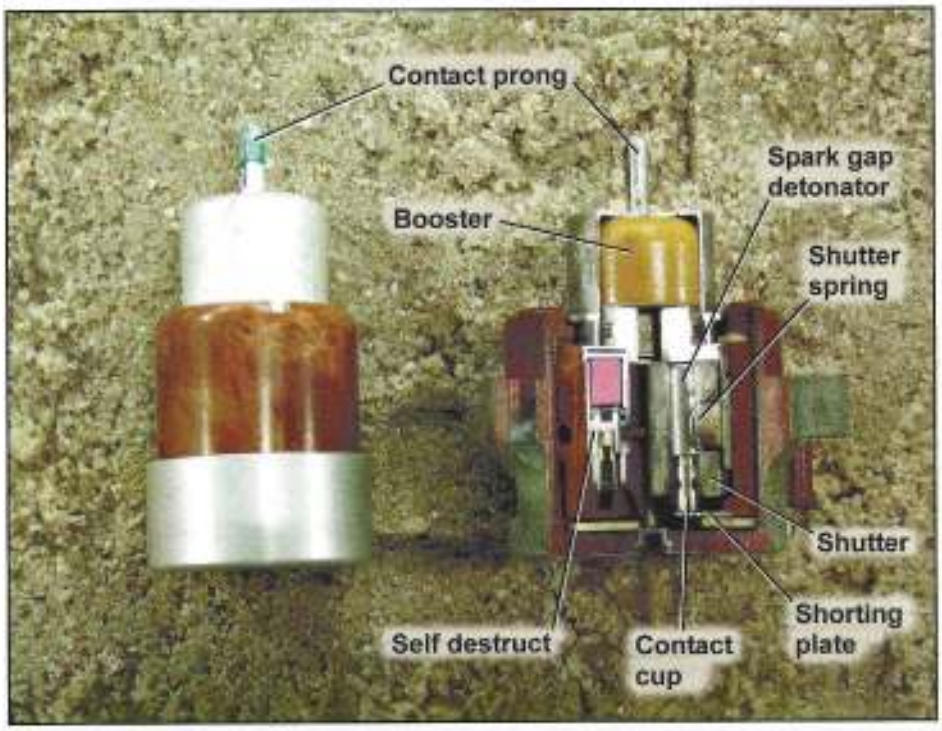


A sectioned PG-2 warhead, showing the relatively simple inertia fuze (Colin King) 1374686



A sectioned PG-9 warhead and fuze. Note also the set-back igniter for the rocket motor, to the right (Colin King) 1374687



Electrically initiated RPG fuzes, showing some of the major components (Colin King) 1374685

RUSSIAN RPG FUZES

Description

VP-7M

The fuze most commonly used in RPG-7 ammunition is designated VP-7M; similar fuzes are also used in 73 mm PG-9, RPG-16, RPG-18 and Yugoslav M-80 HEAT rounds.

The fuze is located at the rear of the warhead assembly, behind the shaped charge and in front of the rocket motor. VP-7M is a Point-Initiating Base-Detonating (PIBD) fuze, electrically initiated by a piezo-electric element mounted in the nose of the warhead. One electrical connection is made from the outer skin of the warhead, which contacts the metallic cup forming the base of the fuze. The second connection is via a prong at the front of the fuze, which contacts the rear of the shaped charge cone; this, in turn, is connected to the piezo element by an insulated aluminium liner within the nose of the warhead.

The main body of the fuze is made from Bakelite plastic, and incorporates a set-back igniter, a self-destruct unit and spring-loaded shutter containing a spark-gap detonator. There are also pyrotechnic elements and detents which perform safety and arming functions. The base of the fuze body sits in an aluminium cup, which acts as an electrical contact and also incorporates a central threaded hole; this can be used to extract the fuze from the warhead during disassembly.

The forward section of the fuze is a booster charge (6.5 g of PETN), housed in an aluminium magazine; the end of the housing is extended into a prong to form a second electrical contact.

PG-2

The PG-2 fuze is far simpler, with a metallic casing containing an inertia striker and single mechanical detent. The forward section of the fuze houses a booster with a central stab-sensitive detonator.

Operational details

Typical operation

VP-7M

When the rocket is fired, the set-back forces an igniter down onto a firing pin; the resultant flash ignites the self-destruct delay element and a separate pyrotechnic pellet, which burns away to release a shutter detent. Firing set-back also releases a ball from a mechanical detent, which also unlocks the shutter. With both restraints removed, the shutter is pushed across to the armed position by one or two springs (depending on fuze type). The electrical contact cup at the base of the shutter slides off the shorting plate and onto the base contact. In the armed position, the detonator is aligned with a relay charge on the axis of the fuze, immediately below the booster.

On impact with the target, the nose-mounted piezo crystal produces an electrical pulse, which initiates the spark-gap detonator, relay charge and booster; this fires the main (RDX/wax) shaped charge warhead. If the piezo element is not activated, the pyrotechnic self-destruct delay (4.8 seconds) fires a flash detonator adjacent to the spark-gap detonator to initiate the explosive train.

PG-2

In the PG-2 fuze, the set-back on firing releases a spring-loaded detent to free the inertia striker. On impact, the striker overcomes its creep spring to drive the firing pin into the stab-receptor.

EOD considerations

- Fuzes may be armed by shock or inertia
- PG-2 fuzes are sensitive to impact, once armed
- PG-7 type fuzes will self-destruct 4.8 seconds after arming (see *Notes*)
- Partially impacted piezo elements can be in a sensitive condition.

Typical specifications

Type:	Russian VP-7M DU
Operation:	Set-back armed, electrically initiated
Typical application:	PG-7M
Length:	74 mm
Diameter:	35 mm
Explosive content:	6.5 g PETN, plus detonators and relay charge

Notes

If a VP-7 type fuze is armed in an accidental explosion, kick-out from a demolition, EOD action or other form of violent inertia (such as dropping from a height onto a hard surface), the self-destruct element will detonate the warhead after the 4.8 second delay. Chinese versions of this fuze do not incorporate a self-destruct.

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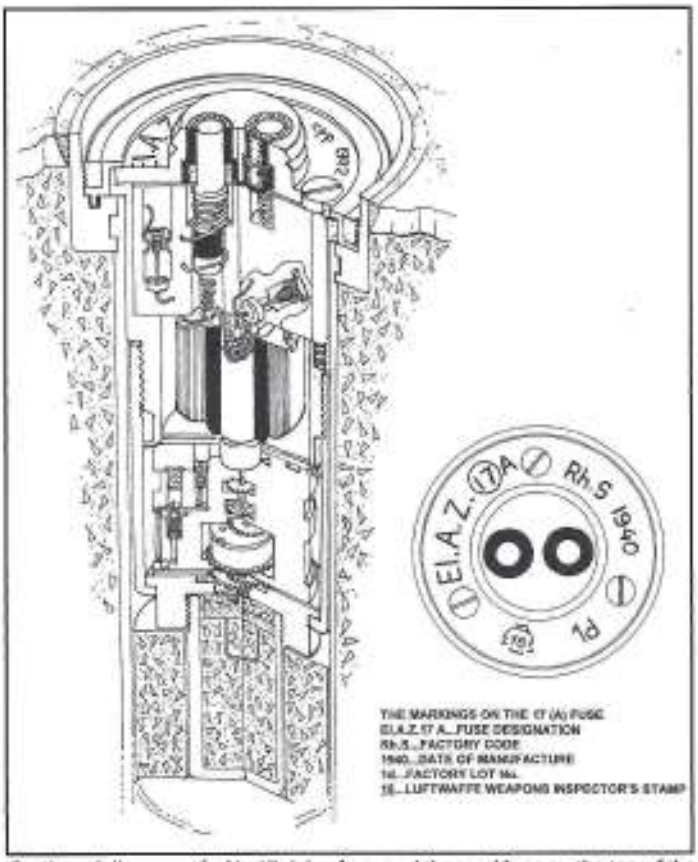
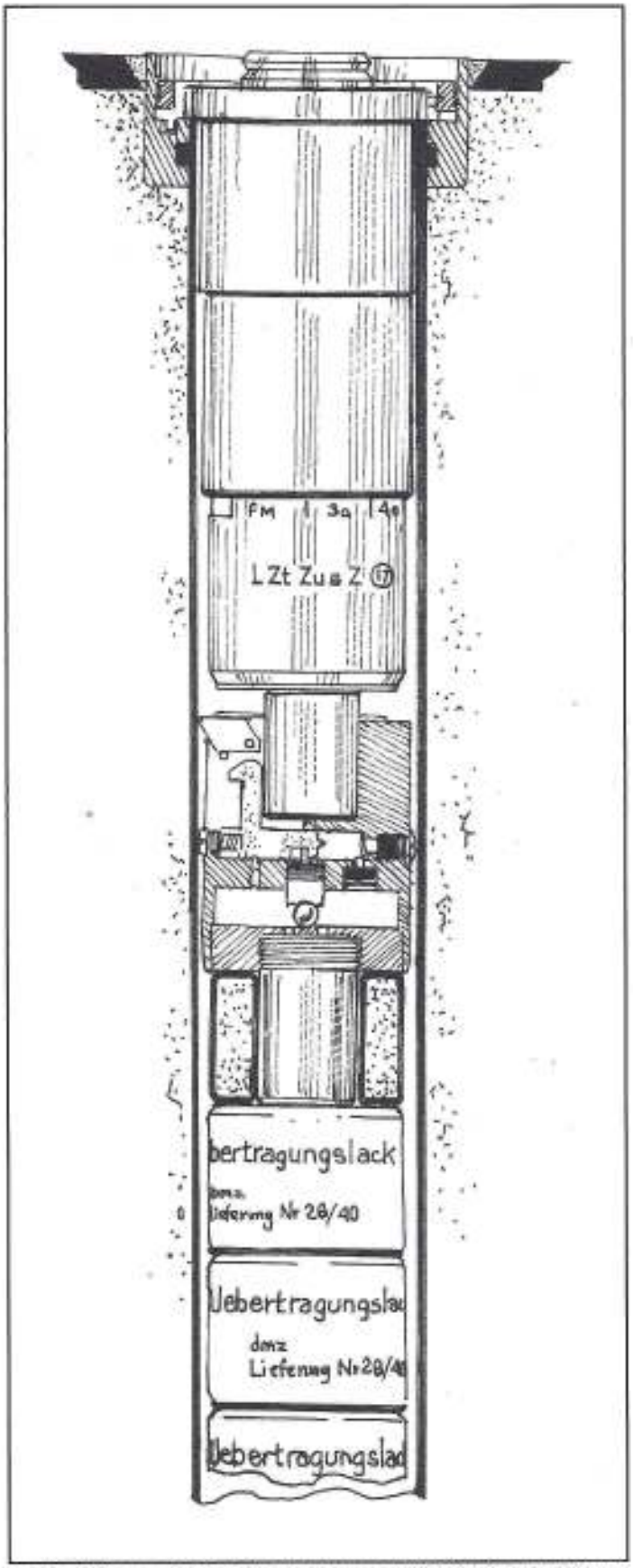

E.l.A.Z. (17) A (1) Rh.S 1940 (1) 42 (19)
THE MARKINGS ON THE 17 (A) FUSE
E.l.A.Z. 17 A...FUSE DESIGNATION
Rh.S...FACTORY CODE
1940...DATE OF MANUFACTURE
42...FACTORY LOT No.
19...LUFTWAFFE WEAPONS INSPECTOR'S STAMP

Sectioned diagram of a No 17 delay fuze, and the markings on the top of the fuze (Lyn Haywood) 0074170

The No 50 anti-disturbance fuze (Colin King) 0074684



Sectioned diagram of a No 17 fuze, booby trapped with a Zus 40 anti-withdrawal device (Lyn Haywood) 0074171

The Zus 40 is a mechanical booby trap. It has a simple spring-loaded striker mechanism, retained by the booster capsule or 'gaine' at the base of the fuze, and functioned when the fuze was withdrawn
(Colin King)
1121276

SECOND WORLD WAR GERMAN BOMB FUZES

Fuzes

Most Second World War German bombs had transverse fuzes (entering the side of the bomb), which were electrically armed on release from the aircraft via two plungers in the fuze head. The charge was held in a reservoir capacitor, which then charged a firing capacitor via a bleed resistor. The value of this resistor determined the arming time; the higher the resistance, the longer the arming period. Most of the fuze types were also electrically initiated, the major exception being the No 17 long delay fuze.

Main fuze types

Impact

Impact fuzes, typified by the No 15 fuze, could be set for instantaneous initiation, or a choice of two pyrotechnic short delays (8 s or 0.05 s), by the bomb aimer. This was achieved by charging through either or both of the plungers. The arming time was either 2 or 8 seconds. These fuzes could be safely discharged simply by depressing and earthing the fuze plungers.

Anti-disturbance

The No 50 anti-disturbance fuze was introduced in 1940, and incorporated a highly sensitive trembler switch. The arming time was increased to several minutes by fitting a high-value bleed resistor between the reservoir and firing capacitor, after which the bomb could be initiated by the slightest movement (experimentally determined at 0.15 mm for a duration of 0.025 s). Pressing one of the charging plungers would also cause initiation, eliminating the use of a fuze discharger as a render-safe option.

Long delay

The No 17 fuze incorporated an electrical arming and initiation system similar to that of the instantaneous impact fuze, but used this to release a clockwork delay mechanism via a pyrotechnic pellet. Removal of the fuze was countered by the 'ZUS 40', a simple mechanical anti-withdrawal device fitted in the fuze pocket at the base of the No 17 fuze booster. The booster of the fuze retained a spring-loaded striker, which would detonate the bomb if the fuze were removed. Three hinged knife edges around the top edge of the ZUS 40 contacted the walls of the fuze pocket to prevent the device being pulled out along with the fuze. Another method of protecting the No 17 fuze was to fit an additional anti-disturbance No 50 fuze, hence the two fuze pockets found in some SC bombs.

German fuzes were stamped with letters and numbers to indicate their function; the number may be prefixed by another digit, but it is the last figure that is significant. The following table shows the designations used.

Letter	German term	Meaning
AZ	Aufschlag Zünder	Impact fuze
EL	Elecktrische	Electric
L	Lange	Long
Z	Zünder	Fuze
Zt	Zeit	Time
Zus	Zusatz	Extension

Last Number	Letters	Function
1	Z or AZ	Mechanical
2	Z or AZ	Mechanical
3	Z or AZ	Mechanical
4	Z or AZ	Mechanical
5	EL-AZ	General purpose
6	EL-AZ	Special land targets
7		Delay fuzes
8	EL-AZ	Special sea targets
9	EL-AZ, EL-Zt-Z, Zt-Z	Airburst
0	EL-AZ, EL-Z	Anti-disturbance

Explosives

At the base of the fuze was a detonator/booster capsule known as the 'gaine'. The detonator pellet contained a mixture of Lead Azide and Lead Styphnate, while the booster was normally Trinitrophenol (Picric Acid) or PETN and wax. Trinitrophenol tends to form friction-sensitive explosive compounds in contact with metals, such as copper; these can form around the fuze head and between the fuze pocket and fuze body, making it dangerous to withdraw the fuze even when it has been rendered inoperative. A solvent or de-sensitiser should be used if there is any sign of crystal formation on or around the fuze.

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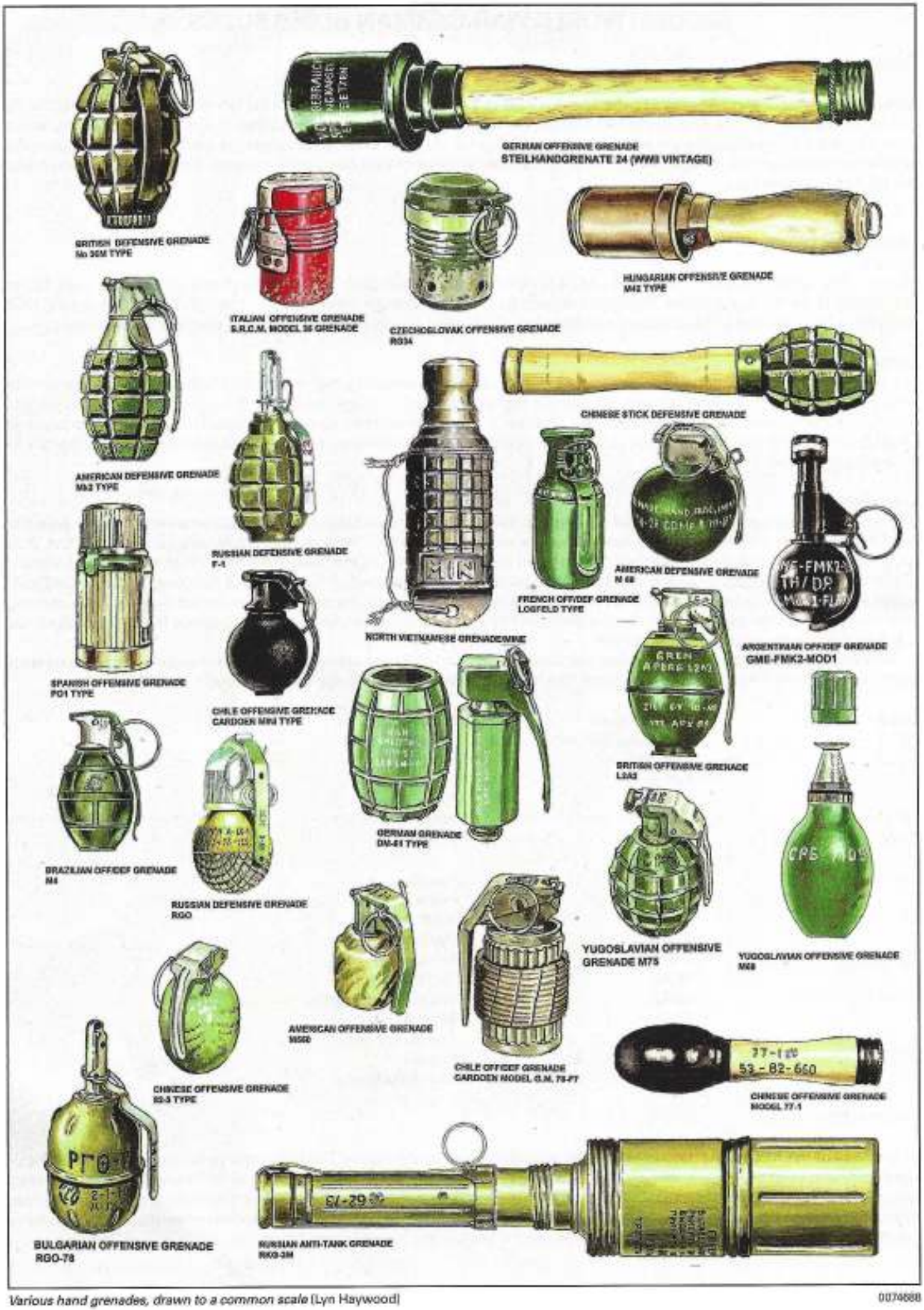

Various hand grenades, drawn to a common scale (Lyn Haywood)

0074888

GRENADES

HAND GRENADES

Description

Hand grenade varieties include blast and fragmentation HE, shaped charge anti-armour, and pyrotechnic fills such as thermite, white phosphorus, photoflash, smoke, illuminants and lachrymatory agents. Fragmentation HE grenades are often known as 'defensive', since they are best used from behind cover. Similarly, blast grenades are termed 'offensive'; they have a smaller danger radius and are intended for use during an attack. As the figure shows, there are many shapes, though most are configured to fit comfortably in the hand; some obsolete designs, known as 'stick grenades', were fitted with wooden handles. The shape of anti-armour High Explosive Anti-Tank (HEAT) grenades is dictated by the warhead design, and these also have handles enclosing a small stabilisation chute. One of the most fundamental design requirements for any hand grenade is that the user must be able to throw it far enough to escape its effects; this effectively limits the mass, and most weigh less than 0.5 kg. Safety and arming features include pins with pull-rings attached, fly-off levers and screw caps to protect impact fuzes. Older fragmentation grenades tended to have thick cast iron or steel bodies, while newer types often use notched steel coils or ball bearings set into plastic casings. Most of the other grenade types have thin sheet metal casings.

Operational details

Typical Operation

The grenade is normally gripped in the throwing hand before the primary safety feature is removed, although some hand grenades can also be fired using rifles fitted with adapters. In most cases, the throwing hand grips a fly-off lever, securing it into position, while the other hand is used to extract the safety pin. As the grenade is thrown, the fly-off lever is jettisoned as it releases a spring-loaded striker onto a percussion cap, which initiates a pyrotechnic delay to the detonator. In some older designs, the user must initiate the pyrotechnic delay by pulling a friction igniter, operating a striker release mechanism or striking a percussion cap, before throwing the grenade. Most hand grenades incorporate a pyrotechnic delay of a few seconds, but some grenades are fitted with impact fuzes; a few of the most modern types are now being fitted with electronic delay fuzes. Delay fuzes are designed to allow the grenade to reach the target, while giving the user time to take cover. The warhead is then initiated on, or near, the target. Delays are generally in the order of 3 to 7 seconds, since an excessive delay might allow the enemy to escape, or even to throw the grenade back.

EOD considerations

- The type of grenade should be identified before taking any EOD action
- Many grenades incorporate 'cocked striker' (spring-loaded) initiation mechanisms
- Corroded components may increase the risk from cocked strikers
- Unexploded impact-fuzed grenades are particularly dangerous since they may be initiated by further movement
- Since many grenades are resilient but light, tamping may be needed for successful demolition.

Typical specifications

Type	Defensive	Offensive	Anti-armour
Example	**UK No 36M**	**Bulgarian RGO-78**	**Russian RKG-3M**
Body diameter:	61 mm	57 mm	78 mm
Height/length:	102 mm	120 mm	388 mm
Weight:	600 g	450 g	1.09 kg
Filling:	60 g TNT	85 g TNT	384 g RDX/TNT
Fuzing:	Delay (4 or 7 s)	Delay (3.2–4 s)	Impact (directional)

Notes

Being simple and inexpensive, hand grenades feature in the inventories of virtually every country with armed forces. Although hand grenades are manufactured in more than 30 countries, many designs are similar, and some are direct copies; this can make accurate identification difficult. Hand grenades are often locally-manufactured or built as Improvised Explosive Devices (IEDs), such as 'pipe bombs' or 'nail bombs'.

For further information, see *Cast fragmentation hand grenades, Anti-armour hand grenades, Pre-formed fragmentation hand grenades* and *Impact fragmentation hand grenades.*

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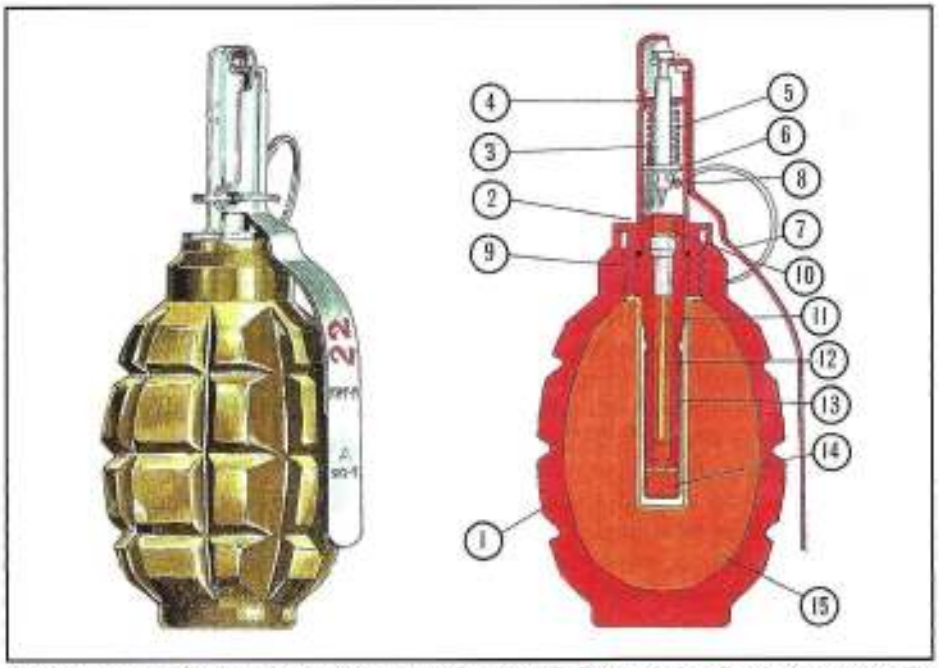
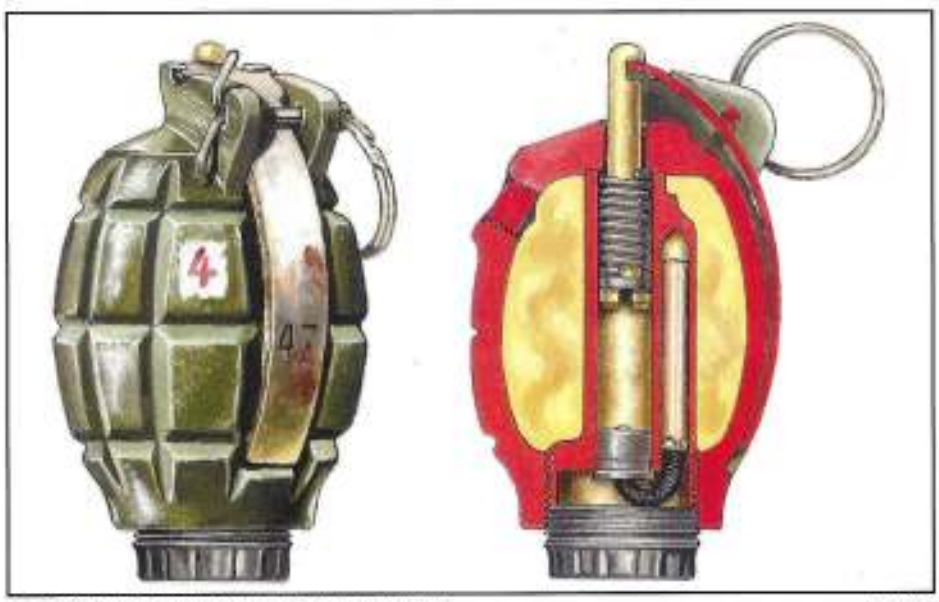


Russian F1 cast fragmentation grenade. **1** *cast iron body* **2** *fuze body* **3** *striker* **4** *pressure washer* **5** *striker spring* **6** *fixed washer* **7** *safety lever* **8** *safety pin* **9** *fuze plug* **10** *percussion primer* **11** *detonator tube* **12** *delay train* **13** *detonator case* **14** *detonator* **15** *main filler TNT* (Lyn Haywood) 0074123

The Russian F1 grenade (Colin King) 0629664

Yugoslav M52P3 grenades with percussion igniters (Colin King) 1289959

Cutaway diagram of the Yugoslav M52, with manually initiated fuze (Lyn Haywood) 0573776



The British No 36M 'Mills bomb' (Lyn Haywood) 0074638

The US M67 (Colin King) 1121167

CAST FRAGMENTATION HAND GRENADES

Description

Cast fragmentation hand grenades are 'defensive' types (designed for use from behind cover) and are composed of two major assemblies, the body and the fuze. The body is made from cast iron or steel and is generally round, ovoid or cylindrical, with a threaded well in the top surface. Older bodies tended to be heavily notched on the outside in an attempt to improve fragmentation; these are sometimes known as 'pineapple grenades'. During detonation, the notching actually has little effect on the break-up of the casing and the fragmentation of older-style grenades is often highly unpredictable. Newer cast bodies are internally notched to break up more consistently, but most manufacturers now use pre-formed fragments or notched metal coils within plastic or sheet metal bodies (see *Pre-formed fragmentation hand grenades*). In older grenades the filling is normally TNT, while some newer types use more powerful explosives, such as Composition B (RDX/TNT). The fuze assembly, which screws into the central well of the main body, normally comprises a fly-off lever with safety pin, spring-loaded striker, percussion cap, pyrotechnic delay element and detonator. The safety pin is normally split and bent apart where it exits the fuze body; this prevents accidental removal or displacement.

Operational details

Typical operation

The grenade is gripped in the throwing hand (thus securing the fly-off lever against the grenade body) and the safety pin removed using the other hand; this requires a significant effort as the ends of the split pin must straighten before they can pass through the fuze body. As the grenade is thrown, the fly-off lever is freed, releasing a spring-loaded striker or hammer onto a percussion cap. This ignites the pyrotechnic delay element (normally between three and seven seconds) which, in turn, initiates the detonator. As the main charge detonates, the body is shattered, projecting fragmentation in all directions. Effective ranges are typically between 10 and 25 m, although large fragments may inflict injuries at far greater ranges. The advantage of the fly-off lever system is that the grenade is not initiated until it leaves the user's hand; this increases safety and allows shorter delay times. In some cases, fuzes are available with a range of optional delay times. In some older designs, the user must manually initiate the pyrotechnic delay by pulling a friction igniter, operating a striker release mechanism or striking a percussion cap, before throwing the grenade. Several of the Yugoslav grenades used in recent Balkan conflicts use these initiation methods, including some locally-manufactured designs.

EOD considerations

- Where possible, fuze assemblies should be stored separately from grenade bodies
- If the fuze cannot be removed, the pin and fly-off lever should be secured using adhesive tape
- Most cast fragmentation grenades incorporate 'cocked striker' (spring-loaded) initiation mechanisms
- Corroded components may increase the risk from cocked strikers
- During demolition, large fragments may travel substantial distances.

This type of grenade tends to fail for one of the following reasons:

- The fly-off lever fails to release properly; this can leave the grenade in a dangerous condition, still able to function
- The percussion cap is not struck sufficiently hard and fails to initiate
- The pyrotechnic fuse is not ignited, or fails to burn through to the detonator
- The fuze assembly is not fitted tightly, or unscrews on landing, separating the detonator from the main charge.

Typical specifications

	Russian F1	US M67	Yugoslav M52P3
Fragmentation	Cast iron	Cast Iron	Cast iron
Diameter:	55 mm	63.5 mm	55 mm
Height:	130 mm	90 mm	108 mm
Weight:	600 g	390 g	450 g
Explosive weight:	60 g	185 g	50 g
Type of explosive:	TNT	RDX/TNT	TNT

Notes

Many hand grenades are similar in appearance and design, and some are direct copies; this can make positive identification difficult. Grenades are often used in simple improvised booby traps in which the safety pin has already been extracted and movement (or tripwire) releases the fly-off lever.

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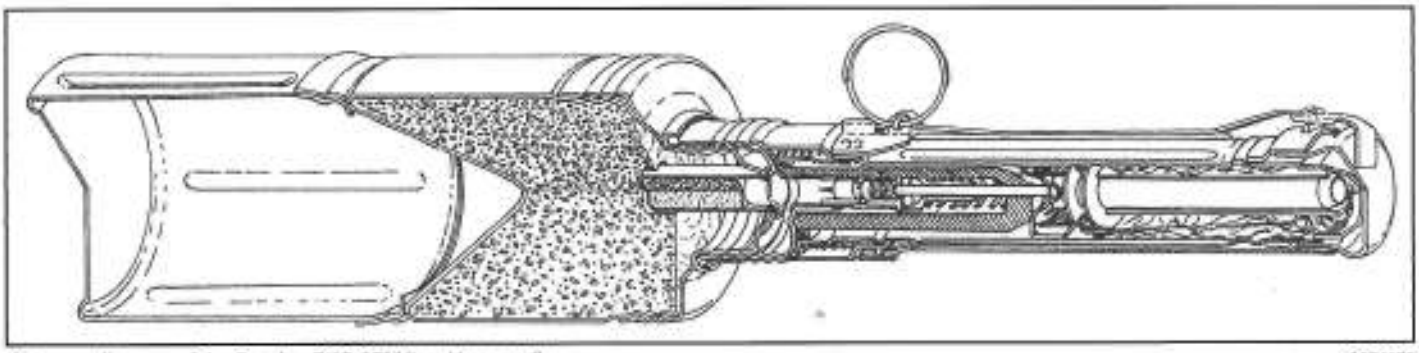
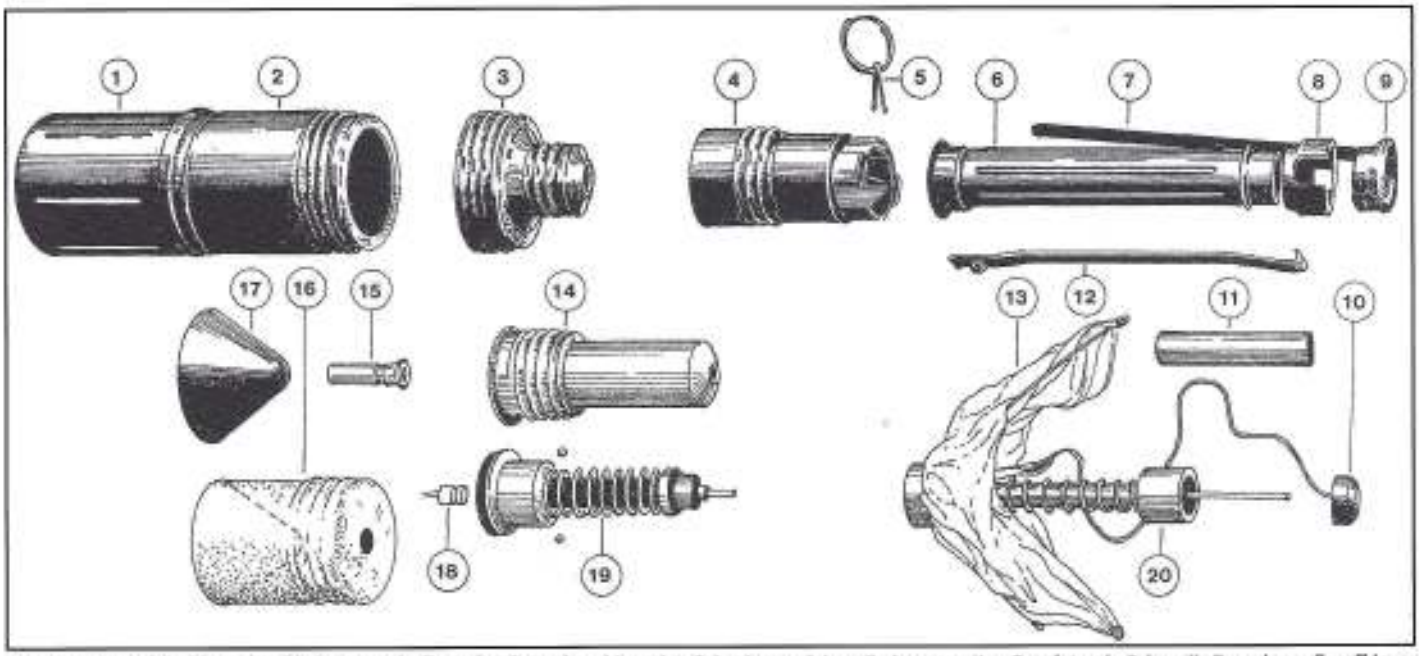
The Egyptian Hassam grenade shown ready for use and fully deployed, with the discarded clam-shell casing in between (Colin King) 0074306

The Russian RKG-3EM, with drogue chute deployed (Colin King, courtesy of DEODS) 0074689



Cutaway diagram of the Russian RKG-3EM (Lyn Haywood) 0074172



Components of the Yugoslav M79. **1** *stand-off section* **2** *warhead housing* **3** *body cap* **4** *handle base section* **5** *safety pin* **6** *handle* **7** *end cap fly-off lever* **8** *handle end ring* **9** *end cap* **10** *drogue deploying weight* **11** *drogue spring tube* **12** *fly-off lever* **13** *drogue chute* **14** *fuze assembly cover* **15** *detonator assembly* **16** *main charge* **17** *shaped charge liner* **18** *striker* **19** *fuze assembly* **20** *drogue deploying assembly* (Lyn Haywood) 0074173

The Russian RKG-3 (top) with the former East German RKG-3Cu below. The 'Cu' indicates a copper cone-shaped charge liner (Colin King) 1121166

The Yugoslav M79 is a copy of the Russian RKG-3 (Colin King) 0529566

ANTI-ARMOUR HAND GRENADES

Description

Most anti-armour hand grenades are similar in design, the majority being closely based on the Russian RKG-3 series. The most common copies are the Chinese Type 3, the former East German RKG-3 series and the Yugoslav M79, which is also produced in Bosnia-Herzegovina as the RKB M79. The grenades have a HEAT warhead with a hollow section at the front to provide the correct stand-off for the shaped charge. The original Russian RKG-3 had a steel shaped charge liner capable of defeating 125 mm of armour, while later variants and copies tend to use a copper liner to achieve far greater penetration (165–220 mm). Bodies and handles are normally made from sheet steel, other than the RKG-3EM, which is made from aluminium. The tubular handle is fitted with a fly-off lever with safety pin, and contains an impact base-detonating fuzing system and a small drogue chute to stabilise the grenade in flight. The safety pin is split and bent back where it exits the fuze body; this prevents accidental removal or displacement.

The drogue assembly is retained by a cap attached to one lever and secured by another; both levers run down the outside of the handle, on opposite sides. The grenade casing is made from several sheet-metal sections, which screw together. The handle can be unscrewed from the warhead for the installation and removal of the stab-sensitive detonator assembly, which is shipped separately. The fuze assembly is mounted in a separate internal cover, which is threaded into the outer handle and secured by a metal staple to prevent it unscrewing.

Operational details

Typical operation

The RKG-3 series grenades, and copies, work as follows. Once the detonator has been fitted, the grenade is made ready by gripping the handle (to hold down both fly-off levers) and extracting the safety pin. As the grenade is thrown or dropped towards its target, one lever is released and the cap at the end of the handle (attached to the second lever) is pushed off. The drogue chute is deployed, and the central rod is pulled out slightly; this allows retaining balls to fall inwards, freeing the striker collar and the inertia weight. The grenade is now fully armed, with the inertia weight held back by a light creep spring. When thrown, the arming process occurs within a few metres, allowing the attacker to be close to their target. On impact, the weight overcomes the weak spring and slides forward, pushing the striker collar down until the striker retaining balls can escape into a recess. The striker is then driven onto the stab-sensitive detonator assembly by the striker spring. The shaped charge jet is formed in front of the grenade to penetrate the target; a considerable amount of blast is also generated during detonation. Because of the thin sheet-metal casing, the fragmentation hazard to the sides is fairly low, however, the large metal components in the handle create a major fragmentation hazard to the rear.

EOD considerations

- Grenades found with chutes deployed are likely to be armed, and therefore sensitive to inertia
- Armed or damaged anti-armour hand grenades should not be moved
- Grenades should not be handled unless the safety pin and fly-off lever are in place and secure
- Before any attempt to unscrew the warhead and handle, the presence of the fuze-cover securing staple must be verified (see *Notes*)
- Demolition procedures should ensure that the cone of the shaped charge is crushed
- The stab-sensitive detonator assembly contains a substantial booster charge.

Typical specifications

Example	Egyptian Hossam	RKG-3M	Russian RKG-3EM	Yugoslav M79
Body diameter:	63 mm	65 mm	78 mm	76 mm
Length (closed):	192 mm	350 mm	388 mm	397 mm
Weight:	570 g	1.07 kg	1.09 kg	1.15 kg
Explosive weight:	140 g	540 g	384 g	400 g
Explosive type:	RDX/TNT	RDX/TNT	RDX/TNT	RDX/TNT
Fuzing:	Point-initiating base detonating (spitback)	Impact, base detonating	Impact, base detonating	Impact, base detonating

Notes

It is important to note that if the fuze-cover securing staple is not present, unscrewing the handle may result in extension of the mechanism, which is likely to arm the fuze; subsequent sudden tilting or jarring may then cause initiation. The obsolete former East German AZ-58-K-100 and the derivative Hungarian 58-K-100 are similar in design to the RKG-3 series, but have more conical bodies with rounded caps. The Egyptian Hossam has no handle; instead, it is enclosed by a clam-shell casing which opens up as the grenade is thrown. Anti-armour grenades have been used in a number of attacks against security forces in Iraq, often involving several attackers at close range.

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Former Yugoslavian pre-formed fragmentation grenades. From the left: M75, M93 with percussion fuze, 'Zeneva' and M85 (Colin King) 1041026

The Former Yugoslavian M75 hand grenade (Colin King) 0074214

The Dutch V40 is one of the smallest grenades ever made (Colin King) 1289961

Iraqi-produced grenade casings and fragmentation coils (Colin King) 0573777

The Austrian Arges HG 85 contains around 3,500 steel balls 0036395

The British L2A2 grenade uses a notched steel coil for fragmentation (Colin King) 0074639

PRE-FORMED FRAGMENTATION HAND GRENADES

Description

Modern fragmentation hand grenades tend to use pre-formed fragments, rather than shattering a cast steel body. In general layout and function, however, they are similar to the older types described in *Cast fragmentation hand grenades*. Most are composed of two assemblies; the body and the fuze. The body contains the main charge and fragmentation; it is generally round, ovoid or cylindrical and has a threaded well in the top surface to accept the fuze assembly. Unlike older grenades, however, the casing of the body is normally made of plastic or thin sheet metal. The fragments are usually small (two to three mm in diameter) steel ball bearings, which may be set into a plastic or resin matrix; it is not unusual for modern grenades to contain between 3,000 and 4,000 of these fragments. Some older designs (such as the US M26 and British L2A2) use notched, coiled wire to produce around 1,000 fragments. The fuze assembly (comprising the fly-off lever with safety pin, initiator, delay fuse and detonator) screws into the central well in the main body. The safety pin is split and bent back where it exits the fuze body; this prevents accidental removal or displacement. To increase their performance, modern grenades tend to use RDX or PETN-based explosives rather than TNT. The outer surface of these modern grenades may be smooth, or ribbed to increase grip. In addition to their increased consistency and lethality, the pre-fragmented grenades tend to be lighter and more compact than the types with cast steel bodies. Even among pre-formed fragmentation grenades, the overall size and weight have been gradually reduced during recent years, with most modern grenades weighing between 300 and 400 g and some 'mini grenades' well under 200 g.

Operational details

Typical operation

The grenade is gripped in the throwing hand (thus securing the fly-off lever against the grenade body) and the safety pin removed using the other hand. This requires a significant effort, as the ends of the split pin must be straightened before they can pass through the fuze body. Some newer grenades incorporate disengagement systems that require additional actions, such as rotation, before the pin can be extracted. As the grenade is thrown, the fly-off lever is freed, releasing a spring-loaded striker or hammer onto a percussion cap. This ignites a pyrotechnic fuse (normally between 3 and 7 seconds) which, in turn, initiates the detonator. As the main charge detonates, fragments are projected in all directions. Unlike cast-body grenades, the pre-formed fragments disperse fairly uniformly. These grenades are typically lethal at ranges between 10 and 25 m and are dangerous to between 50 and 75 m. Electronic fuzes are becoming increasingly popular, with grenades such as the British E105 and Spanish Alhambra already in service. Electronic fuzes offer precise delay timing and silent operation, since there is no percussion cap explosion and no fly-off lever falling to the ground.

EOD considerations

- Most fragmentation grenades incorporate 'cocked striker' (spring-loaded) initiation mechanisms
- Corroded components may increase the risk from cocked strikers
- Where possible, fuze assemblies should be stored separately from grenade bodies
- If the fuze cannot be removed, the pin and fly-off lever should be secured using adhesive tape.

This type of grenade tends to fail for one of the following reasons:

- The fly-off lever fails to release properly; this can leave the grenade in a dangerous condition, still able to function
- The percussion cap is not struck sufficiently hard and fails to initiate
- The pyrotechnic fuse is not ignited, or fails to burn through to the detonator
- The fuze assembly is not fitted tightly, or unscrews on landing, separating the detonator from the main charge.

Typical specifications

Example	Austrian Arges HG 85	Yugoslav M75	UK L2A2
Fragmentation:	3,500 steel balls (2–2.3 mm)	3,000 steel balls (3 mm)	Notched, coiled wire
Diameter:	57 mm	57 mm	60 mm
Height:	96 mm	89 mm	106 mm
Weight:	340 g	355 g	395 g
Explosive weight:	50 g	36 g	170 g
Type of explosive:	PETN	RDX-based plastic	TNT/RDX

Notes

Many hand grenades are similar in appearance and design, and some are direct copies; this can make positive identification difficult. Grenades are often used in simple improvised booby traps in which the safety pin has already been extracted and movement (or tripwire) releases the fly-off lever.

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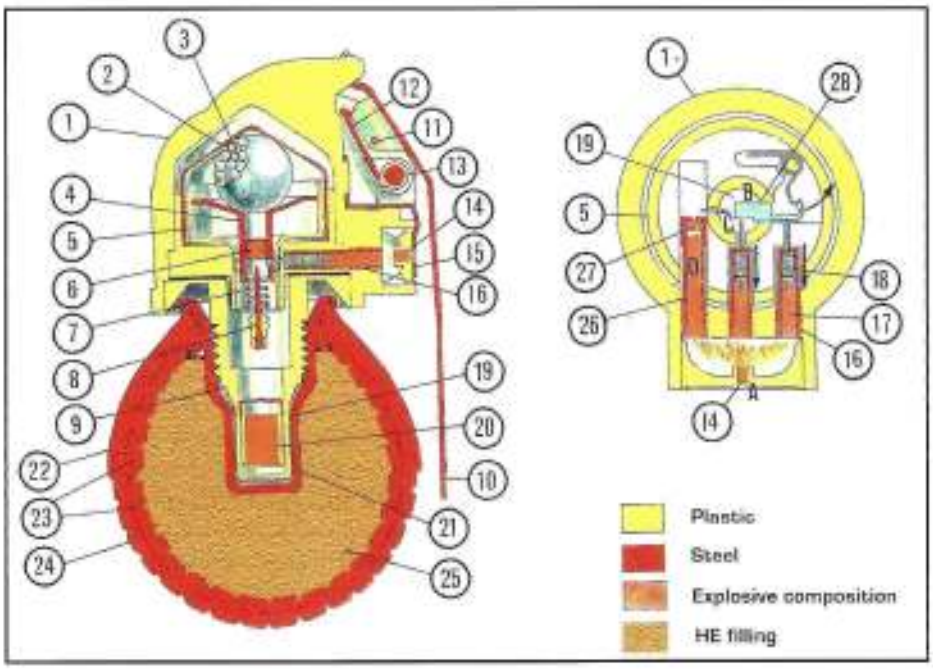

The Russian RGO fragmentation grenade, which incorporates an impact fuze. **1** *fuze body* **2** *impact mechanism cover* **3** *impact weight, lead shot in resin matrix* **4** *impact plunger* **5** *transparent plunger housing* **6** *impact detonator* **7** *buffer spring* **8** *striker* **9** *detonator housing* **10** *safety lever* **11** *safety pin* **12** *hammer* **13** *hammer spring* **14** *primer pellet* **15** *primer housing* **16** *delay tube* **17** *combustible material* **18** *détente pin and spring* **19** *detonator tube* **20** *detonator* **21** *detonator well* **22** *outer body shell – top* **23** *prefragmented inner body shells* **24** *prefragmented outer body shell – bottom* **25** *main filler RDX/wax* **26** *delay tube* **27** *relay detonator* **28** *shutter and shutter spring. When the primer explodes (A), all three delay trains are ignited. As the combustible material burns away, the détente pins are withdrawn by spring pressure, releasing the shutter (B) to be rotated out of line by its spring and freeing the impact plunger (C). The delay train (D) explodes the relay detonator after 3.3 to 4.3 seconds* (Lyn Haywood)
1310164

A cutaway of the Spanish M5 grenade, which has impact and delay options. (Colin King) 1041027

Wartime Italian SRCM and OTO Model 35 grenades in Egypt's Western Desert. Both types have all-ways acting impact fuzes (Colin King) 0074690

The Czech RG-86 (Colin King) 1289960

The Russian RGN (left) and RGO (right) (Colin King) 0573780

IMPACT FRAGMENTATION HAND GRENADES

Description

Impact-initiated hand grenades, such as the Italian OTO, have been in use for many years, but are far less common than delay types. The most widely used impact-initiated grenades are the Russian RGO and RGN, which have been used in Afghanistan and Chechnya. These grenades share an unusual fuze, which incorporates both delay and impact initiation. The RGO is a defensive fragmentation grenade, while the RGN is dual-purpose (offensive and defensive). The grenades are very similar in appearance, and both comprise two assemblies: the near-spherical main body and the fuze assembly. The RGO body is made from two concentric layers of notched steel, the inner layer with the notches on the inside and the outer layer with notches visible on the lower half. The RGN body is made from internally notched aluminium, making it substantially lighter (290 g) than the steel variant (530 g). The bodies contain the main charge of RDX/wax, and have large wells threaded to accept the fuze assembly. Both grenades use the UDZS fuze, which is far more complex than that of a conventional grenade. Although fitted with a fly-off lever retained by a safety pin, inside the fuze are three pyrotechnic delay trains and an all-ways acting mechanism containing an inertia ball. The large white polythene fuze casing and rounded body make these grenades easy to identify; they are normally stencilled with black markings on the olive green or light brown bodies.

The US have produced impact variants of their M26 and M67 grenades, designated M57 and M68 respectively, though these are not believed to be in general use. Both grenades are similar in appearance to the base model but use the M217 electrical fuze, which can operate on either impact or delay.

The Spanish M5, which was used in the Falklands War, has impact and delay options, with a self-destruct operating after 8 s if the impact fuze fails to function. It can also be converted from the offensive role to defensive by adding a fragmentation sleeve.

The Czech RG-86 contains approximately 1,900 fragments; it arms 1.2 s after release and self-destructs within 4.6 s if the impact fuze has not functioned.

Operational details

Typical operation

The RGO and RGN operate as follows. Once the pin has been pulled and the grenade has been thrown, the fly-off lever is freed to release a spring-loaded hammer onto a percussion cap. This simultaneously ignites three parallel pyrotechnic delay trains in the fuze body. Two contain spring-loaded détente pins, which secure the all-ways acting mechanism; the third burns down to a relay detonator to initiate the main charge. The first two delays arm the all-ways acting mechanism in 1 to 1.8 seconds. After this, sufficient impact causes the inertia ball to cam the mechanism down, forcing a firing pin into a stab-sensitive detonator. If the impact fuze has not functioned, the third pyrotechnic delay initiates a relay detonator after 3.3 to 4.3 seconds. The flash from either primary detonator is relayed to a larger detonator located in the centre of the main charge.

In the US M217 fuze, a pyrotechnic delay is initiated by a conventional fly-off lever and striker arrangement, but also activates a small thermal battery. For impact initiation, an inertia switch is used to pass current to an electric detonator, but the pyrotechnic fuze can also initiate the grenade within 7 seconds if the electrical fuze does not function.

EOD considerations

- These grenades can fail in the same ways as conventional hand grenades, but have the added complication of an all-ways acting fuze
- The RGO and RGN plastic fuze housing is prone to deterioration and may cause the fuze to function if it cracks away
- The mechanical fuze may be fully armed and functional, even when the delay detonator has failed
- Armed all-ways acting fuzes may be sensitive to movement
- Where possible, fuze assemblies should be stored separately from grenade bodies
- If the fuze cannot be removed, the pin and fly-off lever should be secured using adhesive tape.

Typical specifications

Example	Czech RG-86	Russian RGO	Italian OTO Model 35
Fragmentation:	Pre-formed	Notched steel plate	Internal fragmentation liner
Diameter:	61 mm	61 mm	55 mm
Height:	117 mm	115 mm	87 mm
Weight:	430 g	530 g	210 g
Explosive weight:	42 g	90 g	70 g
Type of explosive:	Plastic	RDX/wax	TNT

Notes

Many other countries have manufactured impact-actuated grenades incorporating all-ways acting fuzes; unless the grenade can be positively identified, the possibility of an impact fuze should always be considered.

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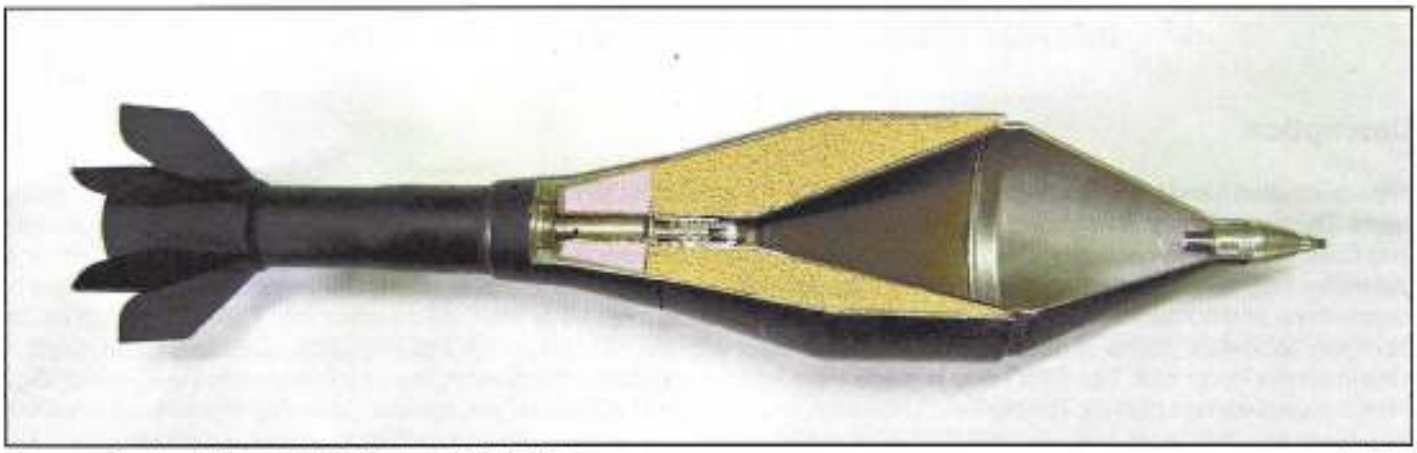
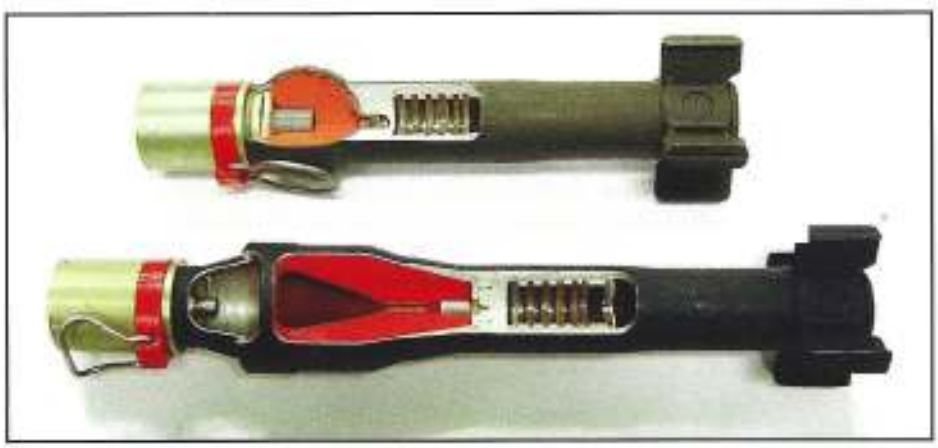


Cutaway of the No. 94 'Energa' HEAT rifle grenade (Colin King) 1375614

Former Yugoslav rifle grenades. From the top: M-83 CS burning, M60P1 HE fragmentation, M83 CS bursting
(Colin King)
0529566



Modern Belgian rifle grenades. Above: HE-RFL-40 fragmentation, below: ARP-RFL-40 HEAT. Note the bullet traps in the tails
(Colin King)
1041028

Former Yugoslavian HEAT/frag rifle grenades M93 (above) and M94 (below), which use the KB-1 and KB-2 submunitions as warheads
(Colin King)
1289962

RIFLE GRENADES

Description

Rifle grenades are normally launched in one of two ways: older types require the use of blank ammunition, while most newer variants can be fired using standard issue 'ball' cartridges. The majority fit over the end of any standard 5.56 or 7.62 mm muzzle (22 mm in diameter) and incorporate a 'bullet trap' which absorbs the impact of the bullet and transfers the energy to the grenade. Some of the newest types will allow any type of ammunition to be used (including tracer and armour-piercing), and one design even allows the bullet to pass through but traps the propellant gas. A variety of warheads are available, but almost all modern rifle grenades have tubular tail sections fitted with fins for stabilisation. Tail sections are often made from plastic, and some telescope to make them more compact during carriage. Some grenades incorporate a small rocket motor to extend their range.

Warhead types include HE blast, fragmentation and HE Anti-Tank (HEAT), with pyrotechnic options including white phosphorus, illuminants, smoke and lachrymatory riot agents; several models combine anti-personnel and HEAT into a dual-purpose warhead. These warhead types are covered in more detail in separate entries. High-performance warheads have increased lethality while enabling the size and weight of modern rifle grenades to be reduced, leading to a corresponding increase in range. Different warhead types may be found in grenades using similar outer casings. It is rarely possible to identify modern rifle grenade types by shape alone; ballistic caps mean that HEAT warheads, for example, may not have their normal characteristic profile.

Operational details

Typical operation

In use, the hollow tail of a rifle grenade is placed over the end of the muzzle of a rifle and the safety device, if fitted, is removed. When a round is fired into a bullet trap grenade, the impact of the bullet is absorbed by a structure within the tail, and the energy transferred to the grenade. Together with the following propellant gases, this projects the grenade at a typical velocity of 50 to 100 m/s. Most older grenades require the use of blank ammunition (with propellant but no projectile). Special sights are used and, in some gas-operated weapons, the gas port is closed to maximise muzzle energy while minimising the chance of damage to the rifle. The inertia experienced during launch is often used to arm the fuze mechanism. Pyrotechnic fills are normally ignited a few seconds after launch, while HE fills are generally detonated on impact by a mechanical fuze. Ranges are typically between 100 m and 400 m, although some extended-range grenades are effective up to 700 m.

Early rifle grenades were often no more than hand grenades adapted for projection using a rifle. Some were fired from a cup fitted to the muzzle and others attached to a spigot that was inserted in the bore. Generally, these grenades used standard pin and fly-off lever hand grenade fuzing systems rather than integral nose or tail fuzes.

EOD considerations

- Unexploded rifle grenades may be fully armed and sensitive to inertia
- It is often difficult to identify the type of warhead by shape alone
- Precautions for shaped charges should be applied if there is any doubt about the warhead type
- Fuze mechanisms vary widely and are not easily identified unless markings are present
- Nose fuzes on unexploded rifle grenades (which have been fired) are likely to be damaged
- Some rifle grenades incorporate a rocket motor.

Typical specifications

Example	Yugoslav M60P1	Yugoslav M60	Belgian Energa
Type:	Fragmentation	Anti-tank	Anti-tank
Diameter:	30 mm	60 mm	75 mm
Length:	307 mm	390 mm	376 mm
Weight:	520 g	610 g	655 g
Fuze:	Point detonating	Base detonating	Point initiating, base detonating
Explosive weight:	60 g	240 g	328 g
Explosive type:	RDX/aluminium	RDX/TNT	PETN or RDX/TNT

Notes

Like hand grenades, rifle grenades are widely manufactured and many are similar in appearance and design. The former Yugoslavia produced an extensive range of rifle grenades, many of very similar shape and some sharing the same designation; particular care is required when identifying these grenades. Some of the larger rifle grenades look very similar to mortar bombs; generally, the tail shaft of a mortar bomb is pierced to vent propellant gas, while the tail shaft of a rifle grenade is not. HEAT warheads may penetrate between 80 and 300 mm of armour.

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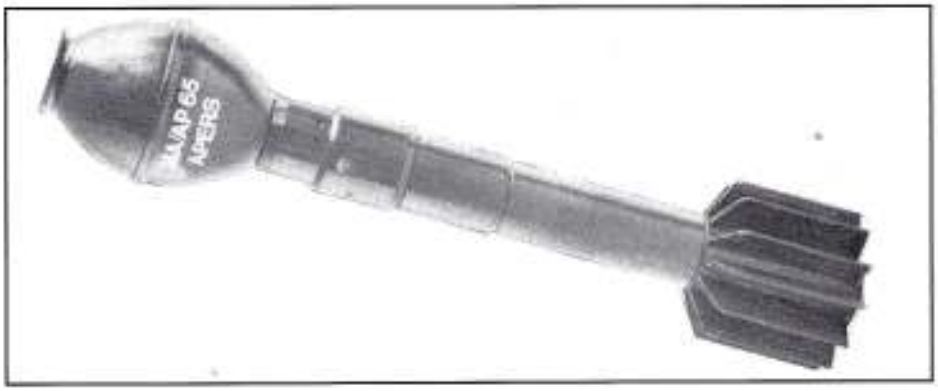
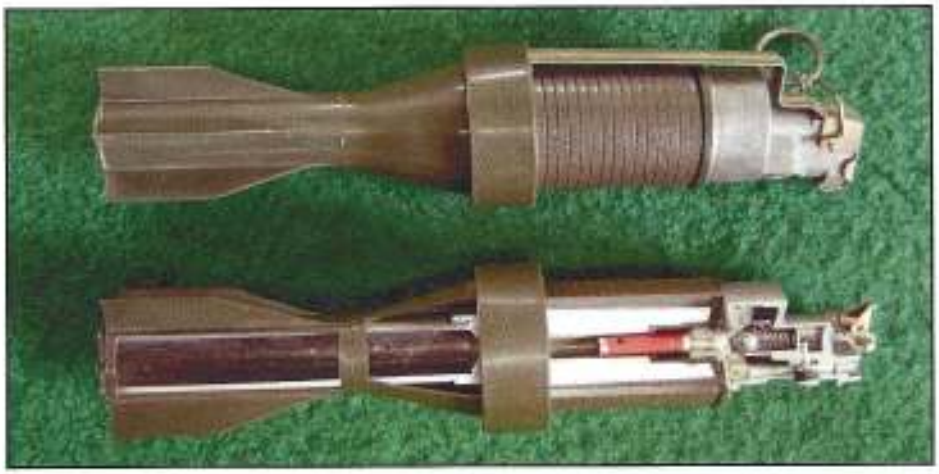
Yugoslav M60 fragmentation grenades (Colin King) 1329903



Israeli MA/AP 65 anti-personnel rifle grenade
0502694



The PRB-103 fragmentation rifle grenade is just a hand grenade with a screw-on tail assembly (Colin King)
1329906

The Belgian RFL-40 fragmentation grenade; note the bullet trap (Colin King)
1329905

RIFLE GRENADES: FRAGMENTATION

Description

Fragmentation, or 'anti-personnel' rifle grenades originated as hand grenades adapted for projection from a rifle, mainly to extend the range at which they could be used. Some rifle grenades, such as the Belgian PRB-103 and Israeli MA/AP 65, still use hand grenade bodies as the anti-personnel warhead. While early versions used a spigot that was inserted down the barrel, all modern rifle grenades have a tail assembly fitted with fins, which fits over the end of any standard 5.56 or 7.62 mm muzzle (22 mm in diameter). Newer variants incorporate a 'bullet trap' and can be fired using standard issue 'ball' cartridges. Warheads are typically smaller than most hand grenades and almost all use notched coils, grooved liners or ball bearings to achieve a consistent fragmentation effect. Several designs combine a shaped charge (for armour penetration) with fragmentation to create a dual-purpose grenade; these are covered in a separate entry; see *Rifle grenades – HEAT*. Most fragmentation rifle grenades use simple mechanical base fuzes, designed to function on impact. Other than those that incorporate hand grenade bodies, fragmentation rifle grenades are much the same shape as other types, making markings vital for identification.

Operational details

Typical operation

In use, the hollow tail of a rifle grenade is placed over the end of the muzzle of a rifle and the safety device, if fitted, is removed. When a round is fired into a bullet trap grenade, the impact of the bullet is absorbed by a structure within the tail, and the energy transferred to the grenade. Together with the following propellant gases, this projects the grenade at a typical velocity of 50 to 100 m/s. Most older grenades require the use of blank ammunition (with propellant but no projectile). Special sights are used and, in some gas-operated weapons, the gas port is closed to maximise muzzle energy while minimising the chance of damage to the rifle. The inertia experienced during launch may be used to arm the fuze mechanism, and to ignite a pyrotechnic self destruct delay, if present. On impact, the fuze detonates the main charge, which projects steel fragments in all directions. A number of rifle grenades use 'graze-sensitive' fuzes to ensure initiation at shallow angles.

EOD considerations

- Unexploded rifle grenades may be fully armed and sensitive to inertia
- It is often difficult to identify the type of warhead by shape alone
- Particular care is needed when identifying former Yugoslav rifle grenades
- Shaped charge cones should be crushed during demolition to prevent jet formation
- The possible presence of a self-destruct delay should be considered
- Fuze mechanisms vary widely and are not easily identified unless markings are present
- Nose fuzes on unexploded rifle grenades (which have been fired) are likely to be damaged
- Some rifle grenades incorporate a rocket motor.

Typical specifications

Example	Belgian PRB-103	Yugoslav M60P1	Israeli MA/AP 65
Type:	Fragmentation	Fragmentation	Fragmentation
Diameter:	50 mm	30 mm	60 mm
Length:	296 mm	307 mm	300 mm
Weight:	665 g	520 g	600 g
Fuze:	Impact	Point detonating	Base detonating
Explosive weight:	80 g	60 g	146 g
Explosive type:	TNT	RDX/aluminium	RDX/TNT

Notes

The former Yugoslavia produced an extensive range of rifle grenades, many of very similar shape and some sharing the same designation; particular care is needed when identifying these grenades. See also *Rifle Grenades, Rifle grenades – HEAT* and *Rifle grenades – pyrotechnic.*

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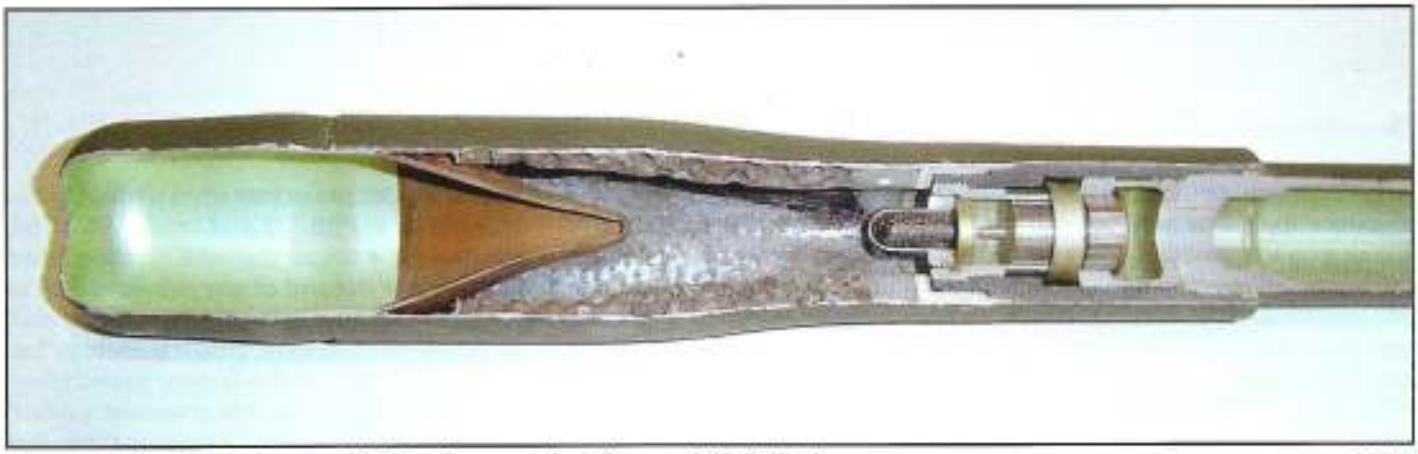

Cutaway of a Yugoslav dual-purpose (HEAT and fragmentation) rifle grenade (Colin King) 1121165

Cutaway of the No. 94 'Energa' HEAT granade (Colin King) 1329909

Yugoslav M60 and M60P2 HEAT granades (Colin King) 1329910

ARP-RFL-40 blank-fired HEAT grenade (Colin King) 1329907

The obsolete 'Energa' grenade
(Colin King)
0573779

RIFLE GRENADES: HEAT

Description

Most High Explosive Anti-Tank (HEAT) rifle grenades have a hollow tail, which fits over the end of any standard 5.56 or 7.62 mm muzzle (22 mm in diameter). The majority are launched using blank ammunition, although newer variants incorporate a 'bullet trap' and can be fired using standard issue 'ball' cartridges. The warhead consists of a shaped charge, using the Munroe Principle to penetrate armour. The explosive charge is located in the rear section of the warhead, behind a conical liner, which is normally made from copper. The open end of the cone is covered by a hollow nose section; this may be elongated, or fitted with a short probe, to create the 'stand-off' needed for the warhead to function efficiently. The charge must be initiated from the rear, which generally involves the use of a mechanical inertia base fuze, or a nose fuze that 'spits back' to fire a detonator at the rear of the charge; this is called 'Point Initiating Base Detonating' (PIBD). Base fuzes may also incorporate a self-destruct feature, designed to initiate the charge within a few seconds if the impact fuze fails to function. A number of dual-purpose grenades combine a fragmentation effect with the anti-armour HEAT warhead; the Yugoslav M93 and M94 grenades achieve this by using the KB-1 and KB-2 dual-purpose bomblets as warheads. The hollow tail boom may be made from metal or plastic, and is fitted with stabilising fins.

Operational details

Typical operation

In use, the hollow tail of a rifle grenade is placed over the end of the muzzle of a rifle and the safety device, if fitted, is removed. When a round is fired into a bullet trap grenade, the impact of the bullet is absorbed by a structure within the tail, and the energy transferred to the grenade. Together with the following propellant gases, this projects the grenade at a typical velocity of 50 to 100 m/s. Most older grenades require the use of blank ammunition (with propellant but no projectile). Special sights are used and, in some gas-operated weapons, the gas port is closed to maximise muzzle energy while minimising the chance of damage to the rifle. The inertia experienced during launch may be used to arm the fuze mechanism, and to ignite a pyrotechnic self destruct delay, if present. On impact, the fuze detonates the main charge, which forms the shaped charge liner into a focused high velocity jet, typically capable of penetrating 80 – 300 mm of armour. A number of rifle grenades use 'graze-sensitive' fuzes to ensure initiation at shallow angles.

EOD considerations

- Unexploded rifle grenades may be fully armed and sensitive to inertia
- It is often difficult to identify the type of warhead by shape alone
- Particular care is needed when identifying former Yugoslav rifle grenades
- Shaped charge cones should be crushed during demolition to prevent jet formation
- The possible presence of a self-destruct delay should be considered
- Fuze mechanisms vary widely and are not easily identified unless markings are present
- Nose fuzes on unexploded rifle grenades (which have been fired) are likely to be damaged
- Some rifle grenades incorporate a rocket motor.

Typical specifications

Example	Belgian ARP-RFL-40	Yugoslav M60	Belgian Energa
Type	HEAT	HEAT	HEAT
Diameter:	40 mm	60 mm	75 mm
Length:	300 mm	390 mm	376 mm
Weight:	520 g	610 g	655 g
Fuze:	Point detonating	Base detonating	Point initiating, base detonating
Explosive weight:	64 g	240 g	328 g
Explosive type:	RDX/wax	RDX/TNT	PETN or RDX/TNT

Notes

The former Yugoslavia produced an extensive range of rifle grenades, many of very similar shape and some sharing the same designation; particular care is needed when identifying these grenades. See also *Rifle Grenades, Rifle grenades – fragmentation* and *Rifle grenades – pyrotechnic.*

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Yugoslav M83 CS bursting grenade (Colin King) 1330212

Yugoslav M62 smoke rifle grenade (Colin King) 1330211

Yugoslav M62 illuminating rifle grenade (Colin King) 1329908

RIFLE GRENADES: PYROTECHNIC

Description

Pyrotechnic rifle grenades have a similar layout to HE types, with a hollow tail made from metal or plastic, and fitted with stabilising fins. The tail boom fits over the end of any standard 5.56 or 7.62 mm muzzle (22 mm in diameter). As with HE rifle grenades, most pyrotechnic types are launched using blank ammunition, although newer variants incorporate a 'bullet trap' and can be fired using standard issue 'ball' cartridges. The most common fillings are smoke mixtures, illuminants and riot agents, such as CS. Other pyrotechnic types include incendiary grenades and practice grenades incorporating a small spotting charge. In addition to the pyrotechnic filling, grenades such as a phosphorus and CS riot agent may incorporate a small bursting charge, while those that dispense their payload, such as parachute illuminants, will have an ejection charge. Since most grenades cannot be recognised by shape alone, colours and markings are the key to identification. The former Yugoslavia produced an extensive range of rifle grenades, many of very similar shape and some sharing the same designation. There is further potential for confusion because most Yugoslav rifle grenades have markings stencilled in yellow on a green background, regardless of role (see *Notes*).

Operational details

Typical operation

In use, the hollow tail of a rifle grenade is placed over the end of the muzzle of a rifle and the safety device, if fitted, is removed. When a round is fired into a bullet trap grenade, the impact of the bullet is absorbed by a structure within the tail, and the energy transferred to the grenade. Together with the following propellant gases, this projects the grenade at a typical velocity of 50 to 100 m/s. Most older grenades require the use of blank ammunition (with propellant but no projectile). Special sights are used and, in some gas-operated weapons, the gas port is closed to maximise muzzle energy while minimising the chance of damage to the rifle. The inertia experienced during launch is generally used to ignite a pyrotechnic delay in a simple base fuze, which then ignites the main filling or initiates an ejection charge once the delay expires. Where a payload (such as a parachute flare) is ejected, the nose section generally separates to release the item.

EOD considerations

- Type identification relies mainly on markings
- Particular care is needed when identifying former Yugoslav rifle grenades
- Pyrotechnic grenades may contain ejection or bursting charges.

Typical specifications

Example	Yugoslav M62	Yugoslav M62	Yugoslav M83
Type	Illuminating	Smoke	CS, bursting
Diameter:	40 mm	40 mm	60 mm
Length:	330 mm	390 mm	420 mm
Weight:	450 g	475 g	475 g (est)
Fuze:	Base initiating, delay	Base initiating, delay	Base initiating, delay
Filling weight:	100 g	200 g	120 g
Filling type:	Illumination mixture	Smoke mixture	CS

Notes

In Yugoslav markings, yellow may indicate a riot agent, a practice munition (sometimes containing live components); it may also signify HE, in accordance with NATO colour codes. See also *Yugoslav ammunition markings*, *Rifle Grenades*, *Rifle grenades – fragmentation* and *Rifle grenades – HEAT*.

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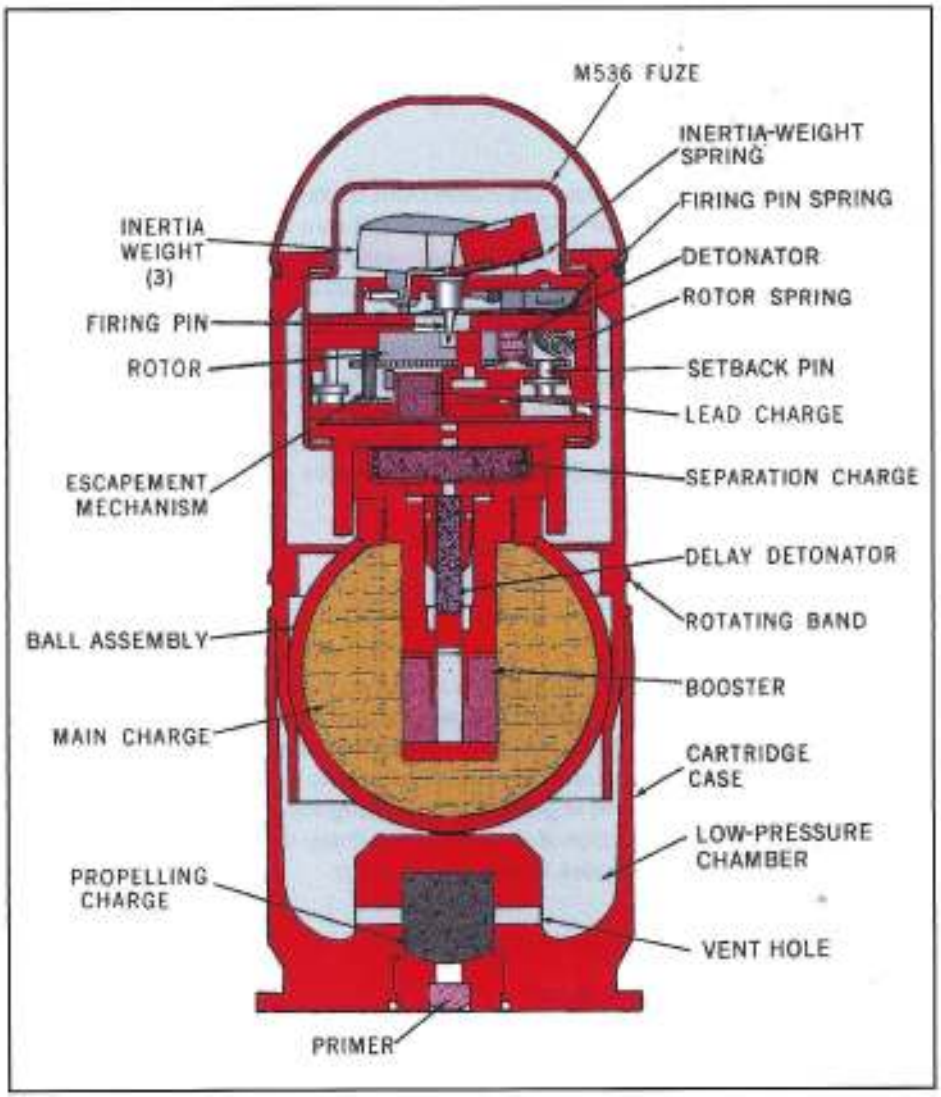

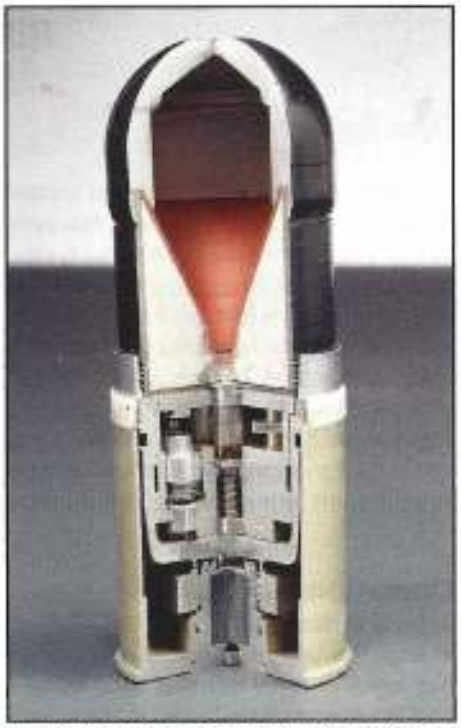

The German DM 12 is a combined (HEAT and fragmentation) 40 mm grenade 0038407

The US M397 has a graze-sensitive fuze that can make the unexploded grenade particularly dangerous
0573781

The Swiss LV Fragmentation Grenade 97. Note the internally notched fragmentation sleeve on the cutaway model 0054738

US HV and LV 40 mm grenades
(Colin King)
1121164

SPIN-STABILISED GRENADES

Description

Unlike rifle grenades, which generally fit over the muzzle of a rifle and are propelled using separate ammunition, spin-stabilised grenades are supplied as complete rounds and fired through a barrel. With the exception of Chinese and Russian 30 mm VOG series grenades (see separate entry), spin-stabilised grenades are standardised on 40 mm calibre. The round uses a rimmed or semi-rimmed cartridge case with a conventional percussion primer and a small propellant charge. Many designs are based on the US 40 × 46 mm low velocity (70 to 80 m/s) series, or 40 × 53 mm high-velocity (about 250 m/s) grenades, which have been produced with a wide variety of warheads (see *Spin-stabilised grenade designations*).

Explosive grenade types include HEAT, HE fragmentation and dual-purpose warhead. Pyrotechnic grenades may contain target markers, illuminants (single or multiple flares, with or without parachutes), flash/bang charges, smoke or lachrymatory agents such as CN or CS. Other types include flechettes, training rounds and anti-riot grenades incorporating 'less lethal' fillings, such as batons, bean bags or rubber balls. 'Video grenades' are also produced; these incorporate miniature cameras, which are deployed on parachutes to transmit images to nearby hand-held receivers.

Most spin-stabilised grenades have a similar domed profile, making it impossible to identify the warhead type from the external shape. However, the majority are clearly marked with colour codes and their designation. Most grenades use mechanical fuzes, although programmable electronic fuzes are being fitted to some of the newer designs.

Operational details

Typical operation

HE Grenades

On firing, the percussion primer ignites a small propellant charge, which is often confined to the centre of the cartridge case and surrounded by a small void. As the grenade is driven up the rifled barrel, both spin and setback forces may be used to arm the fuze. Many types incorporate a pyrotechnic self-destruct delay, which is also ignited during firing and will initiate the main charge (typically, after approximately 20 seconds) if the impact fuze fails to function. The arming of the fuze is normally delayed until the grenade is several metres from the muzzle. Most HE grenades use mechanical impact fuzes, which may be either nose-mounted or base-mounted, but some electronic programmable fuzes are also in use. Since low-velocity grenades must function reliably on impact with soft targets, fuzes are more sensitive than those used in most other projectiles, and some contain 'graze-sensitive' mechanisms. In some cases the domed cap is purely ballistic or simply provides stand-off for the HEAT warhead, while in others it houses a point detonating fuze. HE fragmentation grenades typically incorporate a 30 to 50 g charge, while HEAT warheads normally contain 25 to 35 g of HE. Ball bearings and prefragmented sleeves are often used to maximise the lethality of the HE grenades. Claimed effective fragmentation ranges vary between 5 and 30 m, while HEAT penetration is normally between 50 and 100 mm of armour.

EOD considerations

- During demolition, care must be taken not to launch unfired grenades from their cartridges
- Partially impacted fuzes may make unexploded grenades sensitive to shock
- Fuzes may be located in either the nose or the tail of the grenade
- Despite their size, spin-stabilised grenades can be lethal at significant ranges
- Shaped-charge precautions should be observed if the warhead type is unknown.

Typical specifications

Example	German DM 12	Swiss LV Frag 97	US M397
Type	HEAT/fragmentation	HE fragmentation	HE fragmentation
Calibre:	40 mm	40 mm	40 mm
Weight of round:	265 g	285 g	230 g
Weight of grenade:	224 g	220 g	180 g
Explosive weight:	30 g (est)	40 g	32 g
Explosive type:	RDX/wax	RDX/TNT	HMX/TNT
Fuzing:	Base detonating	Point detonating	Point detonating/graze

Notes

Many spin-stabilised grenades are similar in appearance to, or direct copies of, well-established designs. Wherever possible, markings should be used to aid positive identification before EOD action is taken. A list of designations and functions is given in a separate entry.

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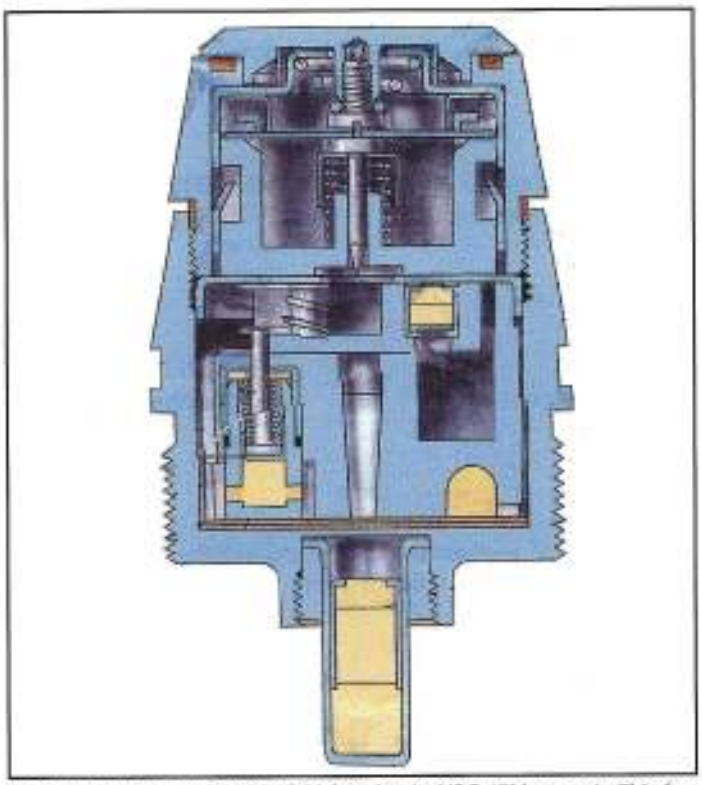
VOG-25 (left) and VOG-25P (right) with the vent holes from the propellant chamber clearly visible at the base of each round (Colin King) 0074696

VOG-25 and cutaway; VOG-25M is externally identical 0008988

VOG-T 'silent' 30 mm HEAT grenade (Colin King) 0074697

VOG-17M 30 mm HE fragmentation grenade. Note the VMG-M fuze 0074695



Sectioned diagram of the VMG-M fuze for the VOG-17M grenade. This fuze incorporates both impact and self-destruct functions 0529567

A cutaway VOG-17 with VMG (impact only) fuze (Colin King) 1329902

SPIN-STABILISED GRENADES: RUSSIAN VOG SERIES

Description

The HE fragmentation grenades in the Russian VOG series are significantly different from most other spin-stabilised grenades. VOG-17 (designated 7P9) has largely been replaced by VOG-17M (7P9M); these are 30 mm grenades fired from a short cartridge case, intended for use in the AGS-17 and AGS-30 grenade launchers. Both have sheet steel bodies covering notched steel fragmentation coils and impact nose fuzes (VMG, VMG-K or VMG-M) made from aluminium.

The VOG-25, VOG-25M and VOG-25P are 40 mm grenades fired from GP-25 and GP-30 launchers (which are mounted beneath the barrel of an assault rifle) or from the six-barrel RG-6. They are caseless and have integral percussion caps leading to propellant chambers in the base. The grenades have nose fuzes with grooved steel bodies designed to create even fragmentation, but while the VOG-25 and 25M are designed to detonate on impact, the VOG-25P incorporates a small bounding charge and a pyrotechnic delay element before the detonator.

VOG-T is a 30 mm silent HEAT grenade with an aluminium body and no integral means of propulsion. It is muzzle-loaded into a BS-1 launcher and fired using a captive piston propelled by a blank cartridge. Smoke grenades (carrying 'GRD' designations), a CS grenade and a baton round are also produced, and have some features in common with the VOG-25 series HE grenades. A thermobaric (fuel-air explosive) round is now believed to be available.

Operational details

Operation

As the VOG-17M grenade is fired from its cartridge, a set-back stab receptor initiates the arming delay and self-destruct pyrotechnic delay element in the VMG-M fuze. The fuze is armed a distance of 10 to 40 m from the launcher, after which any impact should detonate the main charge. If the mechanical impact fuze fails to function, the grenade should self-destruct between 14 and 19 seconds after firing. The older VMG fuze is impact only, and does not incorporate a delay back-up.

With the VOG-25, 25M and 25P, initiation of the percussion cap ignites a Nitrocellulose propellant charge. This vents through holes in the base of the round to launch the grenade and initiate the arming and self-destruct sequence in the same way as the VOG-17. While the VOG-25 and 25M have conventional superquick point detonating fuzes, the VOG-25P incorporates a bounding function. On impact, a small charge behind the fuze in the VOG-25P propels the grenade away from its target (or up off the ground). The charge also ignites a short delay that detonates the main charge after it has travelled 0.5 to 1.5 m; this distance enhances the lethality by allowing a greater spread of fragmentation.

Details of how the VOG-T operates are not available, but it is likely that it also incorporates a mechanical impact fuze with a pyrotechnic self-destruct delay. The thermobaric round is believed to have a single-stage warhead, similar in principle to that used in the Russian RPO-A shoulder-launched rocket.

EOD considerations

- During demolition, care must be taken not to launch unfired grenades
- Once armed, VOG fuzes are particularly sensitive to shock
- Disturbance or EOD action may initiate a self-destruct delay
- Despite their size, these grenades can be lethal at significant ranges
- Shaped charge precautions should be taken with the VOG-T.

Typical specifications

Designation	VOG-17M	VOG-25 and -25M	VOG-25P	VOG-T
Calibre:	30 mm	40 mm	40 mm	30 mm
Type:	HE fragmentation	HE fragmentation	Bounding HE fragmentation	HEAT
Weight of round:	350 g	250 g	278 g	250 g
Length of round:	132 mm	103 mm	124 mm	100 mm
Explosive weight:	34 g	48 g	37 g	n/k
Explosive type:	RDX/wax	RDX/wax	RDX/wax	n/k
Fuzing:	Impact and self-destruct	Impact and self-destruct	Impact delay	Impact

Notes

VOG 30 mm grenades appear to have been copied by China and modified by Cuba. VOG-17M and VOG-25M are also manufactured in Bulgaria.

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SPIN-STABILISED GRENADE DESIGNATIONS

Description

The following table shows the designations of spin-stabilised grenades and indicates their function. All grenades are 40 mm calibre unless otherwise stated. Under the heading *Type*, the abbreviations LV, MV and HV stand for Low Velocity (typically about 75 m/s), Medium Velocity (about 125 m/s) and High Velocity (about 250 m/s). NATO grenades are colour coded (see *NATO colour codes*) and many are marked with their function.

Designation	Country	Type	Remarks
7P17	Russia	LV, HE frag	Alternative designation for VOG-15
7P36	Russia	30 mm, HE frag	Similar to VOG-17M, but 40 g charge
7P9 and 7P9M	Russia	30 mm, HE frag	Alternative designations for VOG-17 and VOG-17M
AGA-40	Romania	HV, HE frag	Impact-fuzed
AG-40	Romania	HV, HE frag	Impact-fuzed
CN 93 and CS 93	Austria	LV, lachrymatory	Contain CN and CS lachrymatory agents
CS 95	Austria	LV, lachrymatory	Contains CS lachrymatory agent
DFJ87-35	China	HV, HEAT/frag	35 mm grenade with mechanical nose fuze
DFS87-35	China	HV, HE frag	35 mm grenade with mechanical nose fuze
DM 11	Germany	HV, HE frag	Nose-fuzed. Contains 42 g HE
DM 12	Germany	LV, HEAT/frag	Base-fuzed. RDX/wax charge
DM 91	Germany	LV, HE frag	Nose-fuzed. Contains 30 g RDX/Al
DRACO	US	LV, HEAT/ frag, thermobaric	Enhanced blast version of the Hellhound
EBX S409	Singapore	LV, enhanced blast explosive	PIBD fuze. Silver body with black cap
GL-204	Brazil	LV, smoke	Various coloured smokes
GRD-00, 40, 150, 200	Russia	LV, smoke	Higher numbers denote greater output
GVOZD	Russia	LV, CS gas	
HE/FRAG 92	Austria	LV, HE frag	Arges grenade. Contains 28 g RDX
HE/DP 92	Austria	LV, HEAT/frag	Arges grenade. Contains 20 g RDX
HEHC	S Africa	LV, HEAT/frag	
HE/HL 93	Austria	LV, HEAT	Arges grenade. Contains 30 g RDX
Hellhound	US	LV, HEAT/frag	Contains 98 g RDX/wax
HUNTIR	US	LV, imaging	Ejects an IR camera on a parachute
HVCC	US	Flechette	Contains 115 17 grain flechettes
HW921	S Korea	LV, HEAT/frag	Contains 45 g RDX
K200	S Korea	LV, HE frag	Contains 32 g RDX/TNT
K212	S Korea	HV, HEAT/frag	Contains 38 g RDX
K220	S Korea	LV, target practice	Contains orange paint
K222	S Korea	HV, target practice	Contains a 3 g flash charge
KM383	S Korea	HV, HE frag	Contains 54.5 g RDX
KM385	S Korea	HV, practice	Inert
KM576E1	S Korea	LV, 'shotgun type'	Contains 20 balls; copy of US M576E1
KM583A1	S Korea	LV, para illum	Contains 93 g of white flare composition
KM662	S Korea	LV, signal	Contains 85 g of red flare composition
LV Frag Gren 97	Switzerland	LV, HE frag	Incorporates self-destruct feature
M381	US	LV, HE frag	Obsolete
M382	US	LV, target practice	Contains yellow dye
M383	US	HV, HE frag	Impact-fuzed
M384	US	HV, HE frag	Incorporates graze-sensitive fuze
M386	US	LV, HE frag	Obsolete
M397	US	LV, HE frag	Incorporates graze-sensitive fuze
M397A1	US	LV, HE frag	Obsolete airburst fragmentation grenade
M406	US	LV, HE frag	Obsolete
M406A	Philippines	LV, HE frag	Nose-fuzed. Contains 32 g Comp B
M407A1	US	LV, target practice	Emits yellow smoke and dye
M430 and M430A1	US	HV, HEAT/frag	Made under licence by several countries
M433	US	LV, HEAT/frag	Uses M550 fuze
M441	US	LV, HE frag	Obsolete
M576E1	US	LV, 'shotgun type'	Contains 20 balls; also produced in S Korea
M583A1	US	LV, para flare (white)	Obsolete
M585	US	LV, multiflare (white)	Obsolete
M661	US	LV, para flare (green)	Contains 85 g of flare composition
M662	US	LV, para flare (red)	Contains 93 g of flare composition. Also produced in S Korea
M674	US	LV, CS agent	Anti-riot
M675	US	LV, smoke (red)	
M676	US	LV, smoke (yellow)	Obsolete

Designation	Country	Type	Remarks
M680	US	LV, smoke (white)	Obsolete
M682	US	LV, smoke (red)	Obsolete
M684	US	HV, HE frag	Proximity fuzed for airburst
M677	US	HV, HE frag	Impact-fuzed, tracer
M713	US	LV, smoke (red)	Contains 75 g of smoke mixture
M715	US	LV, smoke (green)	Contains 75 g of smoke mixture
M716	US	LV, smoke (yellow)	Contains 75 g of smoke mixture
M781	US	LV, target practice	Contains inert orange dye
M8410	S Africa	LV, target practice	Contains orange smoke mixture
M848, M848A1	S Africa	LV, HE frag	Contains 40 g RDX
M8842A1	S Africa	HV, HE frag	Contains 45 g RDX
M8929, M8929A1	S Africa	LV, baton	Solid rubber projectile
M8931	S Africa	LV, incendiary	Contains 32 g of red phosphorus
M9115	S Africa	LV, HEAT/frag	Base detonating fuze
M9219	S Africa	HV, HEAT/frag	
M9602	S Africa	LV, target practice	With 4–7 s tracer
Mod 94	Croatia	LV, HE frag	Contains 40 g RDX
NGB-74	Poland	LV, incendiary	Fired from PALLAD launcher
NGC	Poland	LV, practice	Fired from PALLAD launcher
NGO-74	Poland	LV, HE frag	Fired from PALLAD launcher
NGZ	Poland	LV, practice	Fired from PALLAD launcher
NKOGA	Poland	HV, HEAT/frag	Fired from HV AGLs
NOGA	Poland	HV, HE Frag	Fired from HV AGLs
NT smoke	Germany	LV, smoke	Aluminium body with green plastic cap
Oracle	US	LV, IR flare	IR flare on a parachute
PG-4 FS	Romania	MV, HE	Anti-terrorist blast grenade
PG-4 I	Romania	LV, practice	Inert
PG-4 IGO	Romania	LV, target practice	Contains a tracer and flash charge
PG-4 INC	Romania	LV, incendiary	Contains HE and red phosphorus
PG-4 IRIS	Romania	LV, tear gas	Contains 50 g of CS agent
PG-4M	Romania	LV, HE frag	Contains 30 g TNT
PGA-4	Romania	HV, HE frag	For AGA-40 launcher
RP II	Austria	LV, smoke incendiary	Contains 85 g red phosphorus. Grooved body
RP 92	Austria	LV, smoke incendiary	Contains 45 g red phosphorus. Grooved body
RP-706, 707, 708 and 711	Germany	LV, lachrymatory	Contain CN or CS lachrymatory agent
S401B	Singapore	LV, HEAT/frag	Uses a point initiating base detonating fuze
S405	Singapore	LV, Frag	Uses a point initiating base detonating fuze
S409A1	Singapore	LV, rubber baton	Single rubber projectile
S409A2	Singapore	LV, rubber baton	Multiple rubber projectiles
S411	Singapore	HV, HEAT/frag	Uses a point initiating base detonating fuze
S412	Singapore	HV, HE frag	Point detonating fuze
S413	Singapore	HV, HEAT/frag	Like S411 but with additional self-destruct
S415A	Singapore	HV, target practice	With 7 s tracer
S416A	Singapore	HV, target practice	
S418 ABM	Singapore	HV, HE frag, airburst	Programmable electronic fuze with SD
SPARCS	Singapore	LV, imaging	Ejects a camera on a parachute
Type 93	Austria	LV, flash-bang	Black body with white markings
Type 93	Austria	LV, smoke	Long blunt rounded nose. Green body
Type 102	Austria	LV, HEAT/frag	Contains 40 g RDX
Type 112	Austria	LV, frag	Contains 35 g RDX
UO-40, 40A	Romania	HV, HE frag	For AGA-40 launcher
VGM-93	Russia	43 mm, LV	Thermobaric grenade for GM-94 launcher
VOG-15	Russia	LV, HE frag	Obsolete. Also manufactured in Bulgaria
VOG-17, 17M	Russia	30 mm, HV, HE frag	Contains 34 g RDX/wax
VOG-25, 25M	Russia	LV, HE frag	Also manufactured in Bulgaria
VOG-25P	Russia	LV, HE frag	Bounding fragmentation grenade
VOG-T	Russia	30 mm, LV, HEAT	Silent grenade

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MINES

MINE NOMENCLATURE – FORMER CZECHOSLOVAKIA

The table shows the markings commonly used on former Czechoslovakian mines, which may be stencilled in either English or Cyrillic characters. There are some exceptions, and designations should not be relied on in isolation for identification purposes.

English	Cyrillic	Meaning
I	I	Roman numeral as suffix denotes model number
Ba	Ба	Plastic casing for a mine
D	Д	Wooden casing for a mine
K	К	Metallic casing for a blast mine
Mi	Ми	Mine
NA	НА	Pressure
PP	ПП	Anti-personnel
PT	ПТ	Anti-tank mine
RO	РО	Fuze
Sb	Сб	Concrete fragmentation body
Sk	Ск	Metal fragmentation body
Sr	Ср	Fragmentation (used for bounding mines)
Sv	Св	As a prefix: training
U	У	Universal

Czech term	Meaning
Chemický	Chemical
Electrický	Electrical
Hodinový	Clockwork
Mechanický	Mechanical
Nástraha	Booby trap
Nástražný drát	Trip wire

PT Mi-Ba-III: plastic-cased anti-tank mine; third model (Colin King) 0074032

The Czech PP Mi-Sr designation means 'anti-personnel mine, bounding'. The fuze is RO-8, meaning 'mechanical fuze, 8th design' (Colin King) 0021112

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MINE NOMENCLATURE – FORMER SOVIET UNION

The table shows the markings commonly used on mines from the former Soviet Union, which are normally stencilled in Cyrillic characters. There are some exceptions, and designations should not be relied on in isolation for identification purposes.

English	Cyrillic	Meaning
B	Б	Paper/resin casing for a mine, or 'large' as a suffix (as in TMD-B)
Ch	Ч	Clockwork
D	Д	Wooden casing for a mine
E	Э	Electrical
EKh	ЭХ	Electrochemical combination
K	К	Shaped charge
KhF	ХФ	Chemical mine
M	М	As a suffix: metal casing (as in TM-62M), or modified
MON	МОН	Directional fragmentation mine
N	Н	Pressure activated (as in PMN) or directional (as in MON)
O	О	Fragmentation
OZM	ОЗМ	Bounding fragmentation mine
P	П	As a suffix: plastic casing (as in TM-62P)
PM	ПМ	Anti-personnel mine
S	С	As a suffix: self-destruct (as in PFM-1S)
SB	СБ	Tar-covered casing for a mine
Sh	Ш	Tilt-rod (fuze type)
TM	ТМ	Anti-tank mine
U	У	As a prefix: training version (inert) With a white stencilled bar in place of HE designation
UI	УИ	Training, imitation (generally with a pyrotechnic charge) With a red stencilled bar in place of HE designation
V	В	Fuze or 'exploder' (with a fuze)
Ya	Я	Box (mine)
Z	З	Mines: Obstacle mine, normally omnidirectional (as in POMZ and OZM)
Z	З	Fuzes: Delay

The Russian TM-62P2 designation means 'anti-tank mine, 1962 year of introduction, plastic, 2nd design'. Note the Cyrillic U prefix on both the mine and the fuze, which denotes training models. On inert models, the HE designation is replaced by a white bar (Colin King) 0074053

PMN-2: anti-personnel mine, pressure activated, second model (Colin King) 0021197

MINE NOMENCLATURE – FORMER YUGOSLAVIA

The table shows the markings commonly used on former Yugoslavian mines, which may be stencilled in either English, Latin or Cyrillic characters. There are some exceptions, and designations should not be relied on in isolation for identification purposes. Care is needed during transliteration, as some similar letters have different meanings; see the Cyrillic and Latin transliteration table in the identification section.

English	Latin	Cyrillic	Meaning (Mines)	Meaning (Booby Traps)
1	1	1	Model number	Model number
A	A	A	Non-metallic (blast) or (as a suffix) modified version	
D	D	Д	Wooden (except in MRUD)	
Kh	H	Х	Chemical (friction-sensitive)	
M	M	М	Metallic (as a suffix); or mine	Mechanical
N	N	Н		Pressure operation
O	O	О	Bounding	Pressure release operation
P	P	П	Anti-personnel (AP)	Pull operation
PM	PM	ПМ	AP mine	
R	R	Р	Projected fragmentation	
S	S	С	(As a suffix for an AP mine) Inclusion of a flare	
TM	TM	ТМ	Anti-Tank (AT) mine	
U	U	У	(As a prefix) fuze	(As a prefix) fuze
V	V	В	(As a prefix) practice (not necessarily inert)	(As a prefix) practice (not necessarily inert)

The Yugoslav PROM-1 designation means 'anti-personnel mine, bounding'. Note the U prefix in the fuze designation. TX50 is the designator for an explosive fill (RDX/TNT), KV is the factory code and Ser 03/70 is the lot number and year of manufacture (Colin King) 0021253

PMA-3: anti-personnel mine, 'non-metallic' blast, third model (Colin King) 0074902

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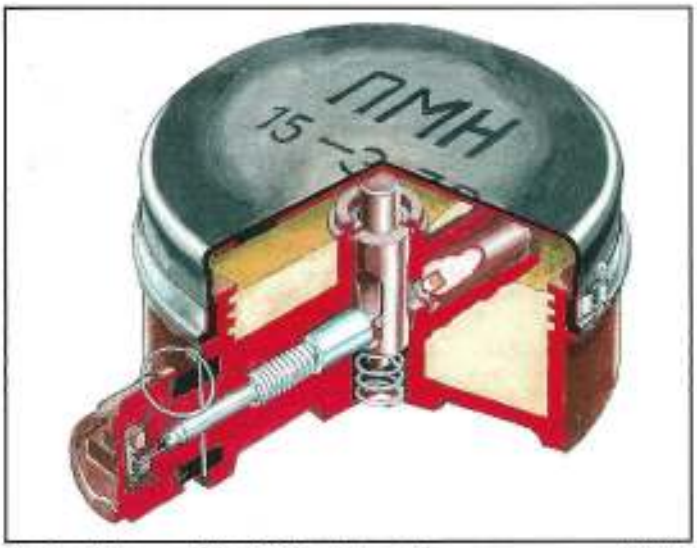
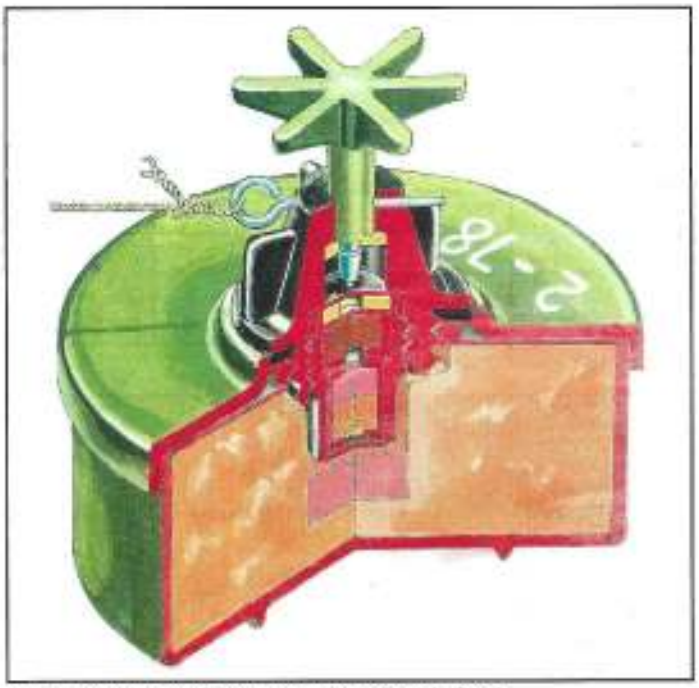
The Russian PMN is one of the largest and most common AP blast mines. The fuze incorporates an arming delay (Colin King) 0074004



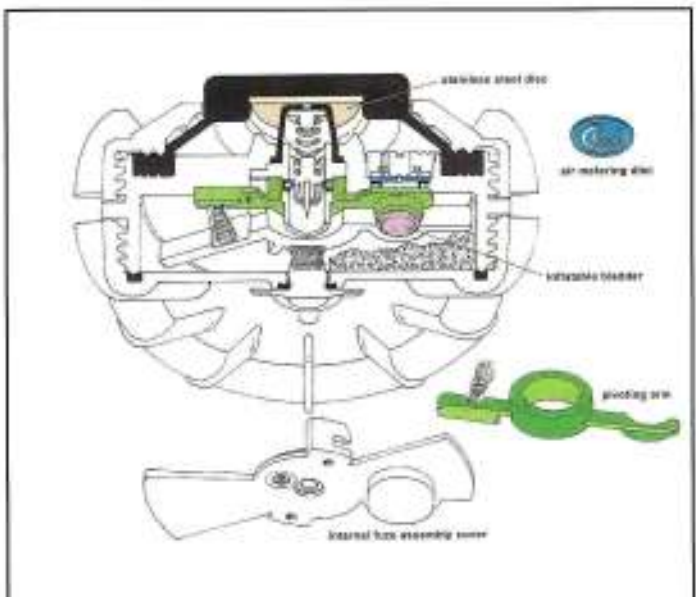
Sectioned diagram of the PMN (Lyn Haywood) 0021346

The Yugoslav PMA-2 (Colin King) 0066071



Sectioned diagram of the PMA-2 with safety pin fitted (Lyn Haywood) 0021345

The Italian TS-50 (Colin King) 0074527



Sectioned diagram of the TS-50, viewed from beneath (Colin King) 0576958

ANTI-PERSONNEL BLAST MINES

Description

The majority of Anti-Personnel (AP) blast mines are pressure-operated, with a mechanical fuzing system initiating a main charge housed in an outer casing. Many AP blast mines use TNT as the main charge, though the smaller mines tend to use more powerful explosives (such as Tetryl), or mixtures (such as Composition B). Plastic casings tend to be used for ease of manufacture, and most are waterproof. The use of metal for the casing is rare, though wood was used in some older designs. Bakelite, a hard phenolic plastic rarely used today, was used extensively by Russia and other former Warsaw Pact countries.

A number of the more modern mines are scatterable, with integral shock-resistant fuzes that enable them to survive the fall from the dispensing system. The same mechanism that makes a mine shock-resistant also tends to make it blast-resistant, which allows the fuze mechanism to resist explosive mine countermeasures. Some AP blast mines are designed with a minimal metallic content in order to make detection more difficult, though most contain some metal. In some mines, stainless steel components are also used to minimise the magnetic signature. Although AP blast mines are rarely booby trapped, electronic versions of some modern mines incorporate an anti-handling device to discourage manual clearance.

One of the oldest configurations is the box type (originally wooden), which uses a hinged lid on a rectangular box body. These are sometimes called 'shoe' or 'shoe-box' mines, a misnomer derived from the Second World War German Schü-mine 42. Most AP blast mines are now cylindrical, with either a smooth pressure plate bearing on an internal fuze or a protruding spigot fuze in a central well. To ensure safety during transit, they tend to have a removable fuze or detonator assembly and a mechanical safety device, which must be removed in order to arm them. The use of irregular shapes (such as the Russian PFM-1) is exceptional and confined to scatterable mines with a requirement for compact packaging.

Operational details

Typical operation

In most cases, a fuze or detonator assembly is inserted and the mine is then laid manually. The mine is armed by the removal of a safety device, such as a pin or a protective cap, before final burial or camouflaging. Some mines (such as the Russian PMN) incorporate a simple delay mechanism in the fuze to allow the setter to leave the area safely before the mine becomes armed. Scatterable mines are normally armed as they leave the dispenser; they incorporate an arming delay or an anti-shock mechanism to prevent them from detonating as they hit the ground. Once armed, the mine is initiated when sufficient force is applied to the top surface. Actuation of the fuze results in the immediate detonation of the main charge. Although the primary effect is blast, all mines create some fragmentation, as well as a 'secondary fragmentation' effect from objects in the surrounding ground. With large Bakelite-cased mines such as the Russian PMN, fragmentation of the casing can substantially increase the mine's lethality.

EOD considerations

- Correct identification is important, since configurations and operating pressures vary substantially between different types
- To avoid loading the pressure plate or fuze spigot, conventional demolition charges are generally placed beside the mine
- Resilient plastic mines and those with large air voids require larger charges or good tamping to ensure destruction
- Burning often works well against plastic-cased mines, and the use of flares or pyrotechnic torches should be considered
- Degradation may make neutralisation and disarming procedures dangerous or impossible

Typical specifications

Example	Russian PMN	Italian TS-50	Yugoslav PMA-2
Fuze type:	Integral, transverse	Integral, blast-resistant	Screw-in, spigot
Metal content:	High (approx 35 g)	Medium (approx 3 g)	Low (less than 1 g)
Diameter:	112 mm	90 mm	68 mm
Height:	56 mm	45 mm	61 mm
Weight:	550 g	186 g	135 g
Explosive weight:	240 g	50 g	100 g
Explosive type:	TNT	RDX	TNT
Operating force:	8–25 kg	12.5 kg	7–15 kg

Notes

Although the size of charge varies considerably between AP blast mines, most are intended to cause serious injury rather than kill. A typical wound will destroy one foot or leg and cause multiple lacerations from casing fragments and surrounding debris. The production, use and transfer of anti-personnel mines is now prohibited under the Mine Ban Treaty (Ottawa Treaty). For more details on mines, refer to *Jane's Mines and Mine Clearance*. See also separate entry: *Common anti-personnel blast mines*.

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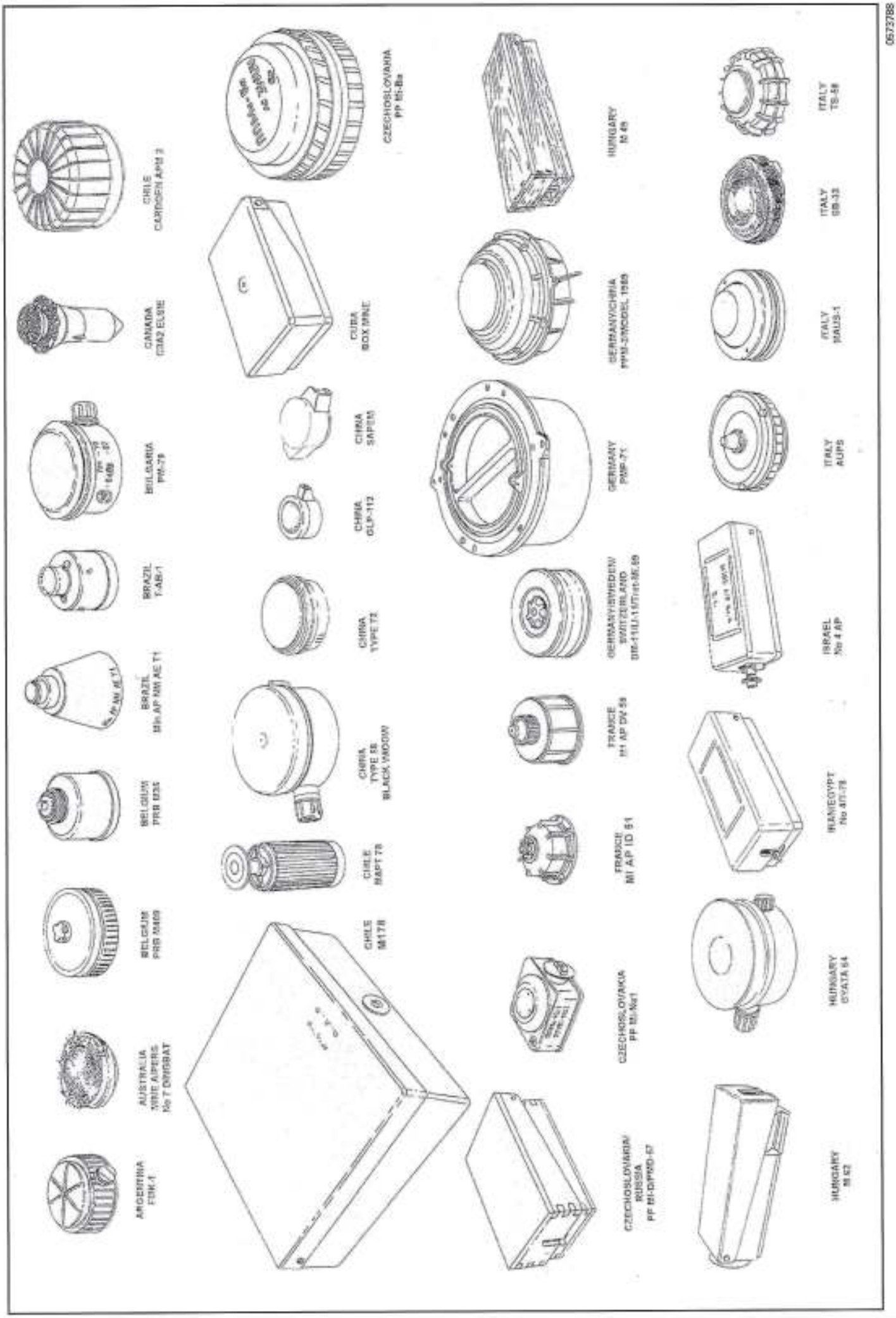
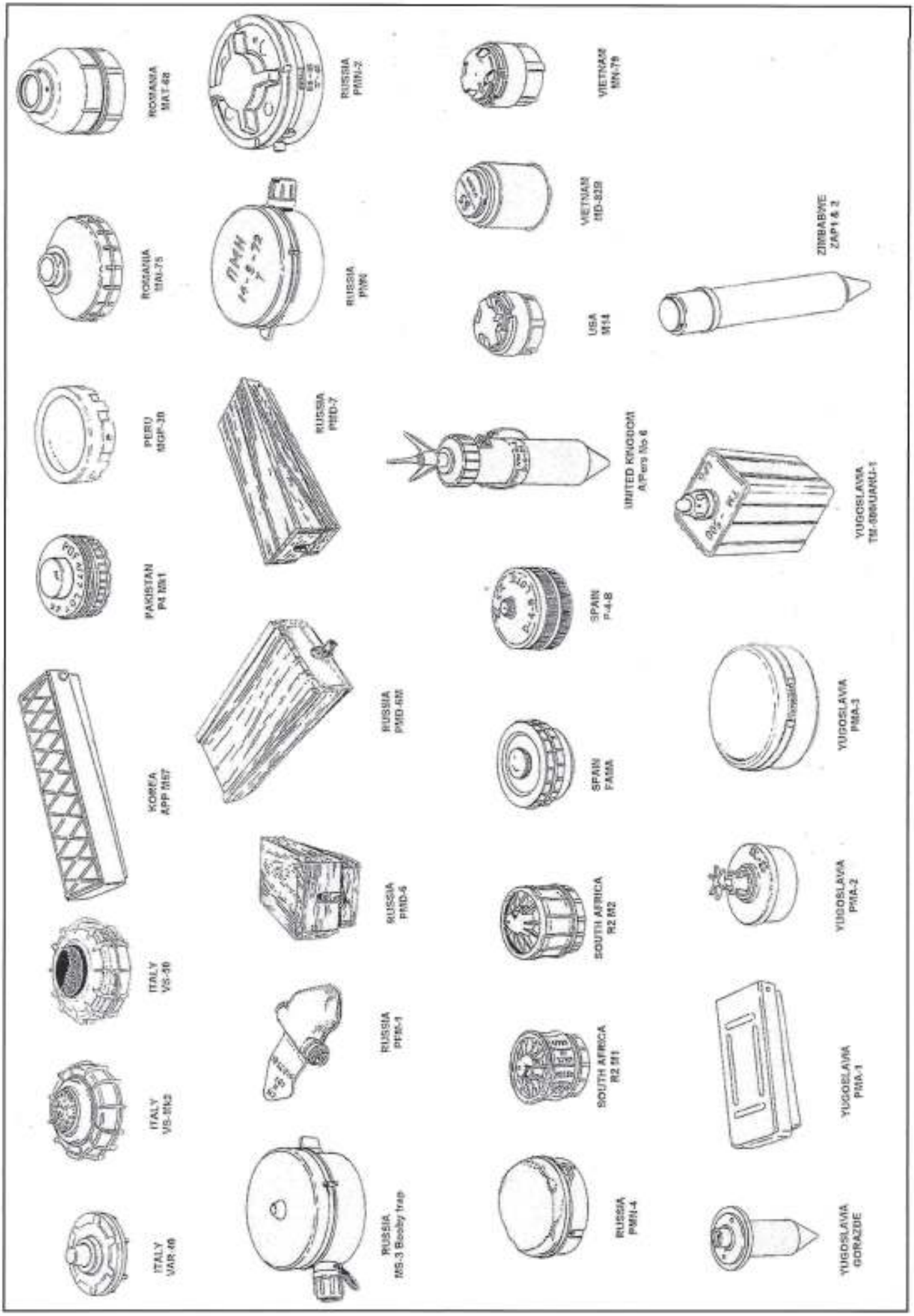
COMMON ANTI-PERSONNEL BLAST MINES





SECTION 3

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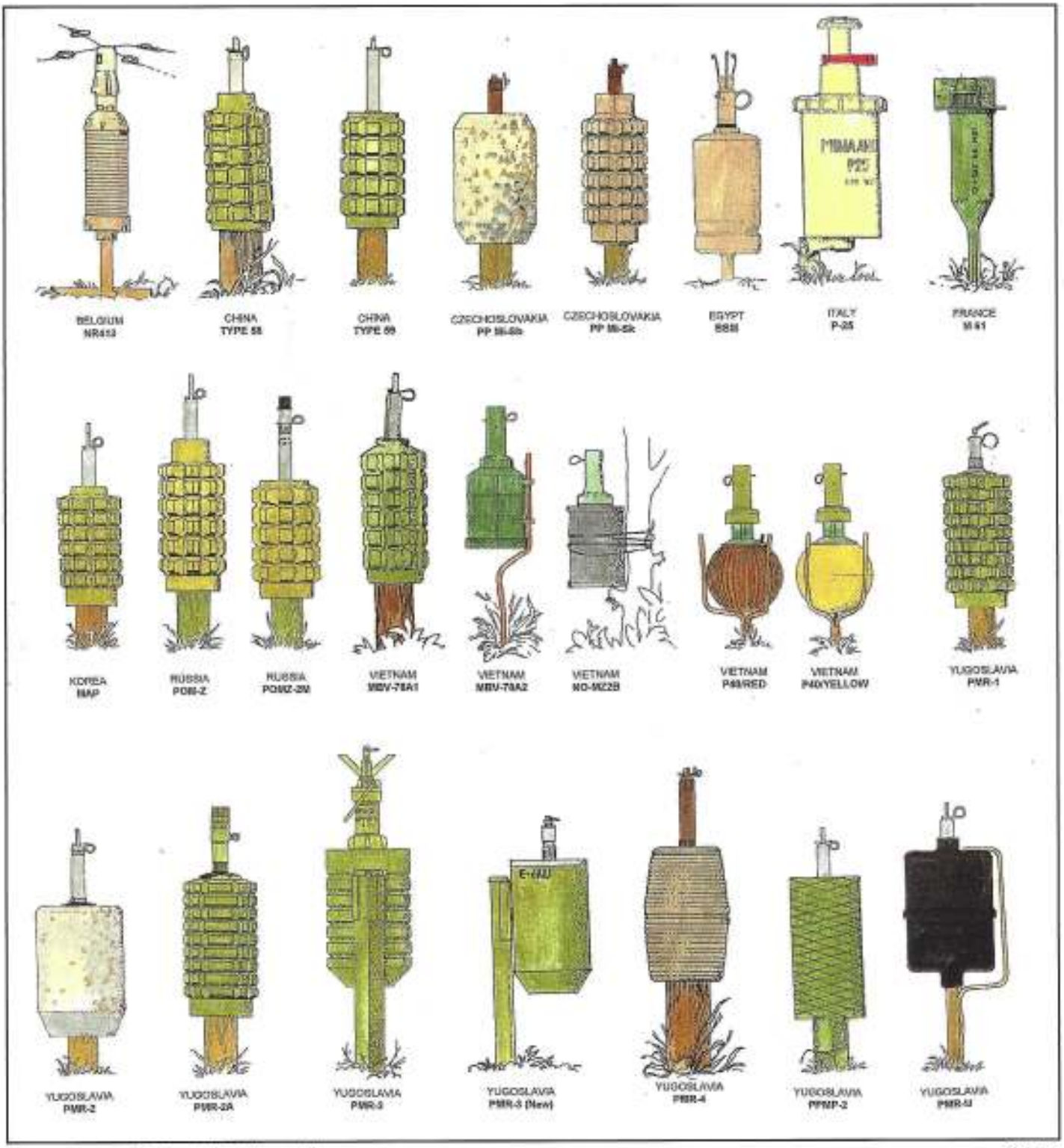
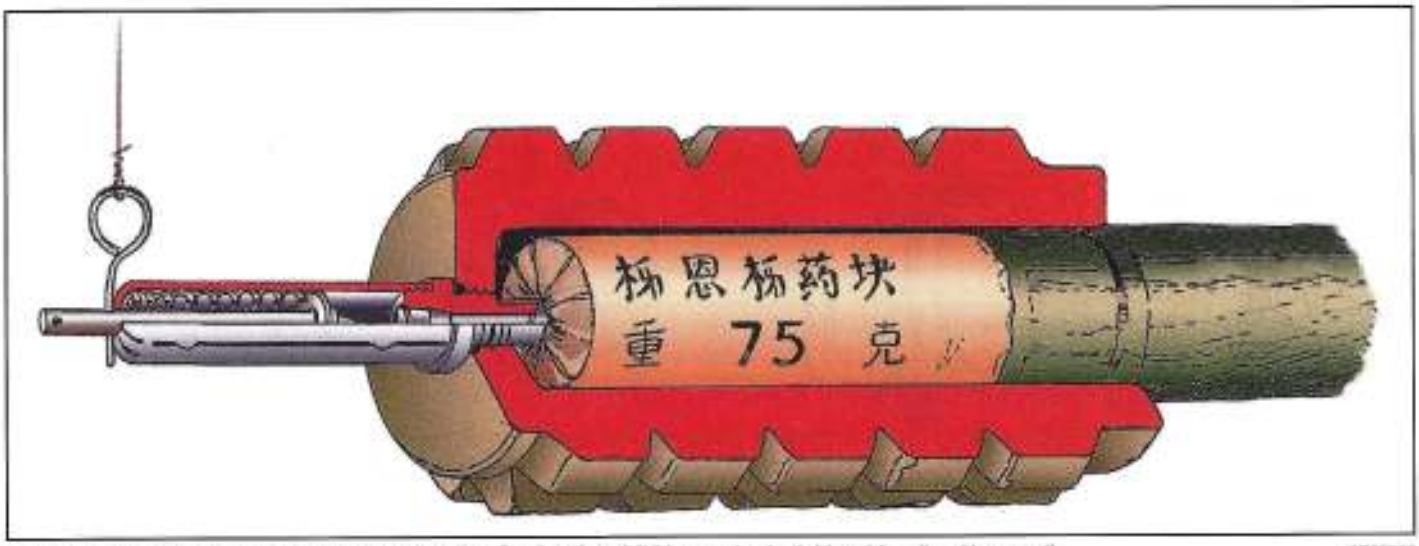


Common types of stake mine (Lyn Haywood) 0021377



Cutaway diagram of the Chinese Type 59 stake mine, fitted with an MUV-type tripwire-initiated fuze (Lyn Haywood) 0529568

ANTI-PERSONNEL FRAGMENTATION MINES

Description

The majority of Anti-Personnel (AP) fragmentation mines are tripwire-operated, with a mechanical fuzing system initiating a main charge housed in a thick metal outer casing. Most use TNT as the main charge and cast iron or steel for the body of the mine; this is often notched or grooved either internally or externally. A mechanical tripwire fuze is inherently resistant to the effects of overpressure, and is normally unaffected by explosive mine countermeasures. Some scatterable AP fragmentation mines have been produced but, because they tend to be complex and expensive to manufacture, they are not in widespread use.

The vast majority of AP fragmentation mines are cylindrical and have the protruding fuze assembly mounted centrally in the top surface. Most are mounted on wooden or metal stakes to optimise the range and effect of the shrapnel, hence the alternative name, 'stake mines'. Some of the older stake mines had concrete bodies containing steel fragments; these have all now been superseded by metal-bodied versions. External grooving gives the older mines a 'pineapple' appearance, while more modern versions tend to have a smooth exterior with internal grooving or pre-formed fragments. One or more anchored tripwires are normally attached to the striker retaining pin, so that pulling the wire actuates the mine. Fuzes sometimes have a safety device (normally a second retaining pin) that must be removed in order to arm the mine. The fuzes are mostly removable as separate assemblies, and some mines have several fuzing options. Fuzes that use stab-sensitive initiators, such as the Russian MUV, have sharply pointed strikers driven by relatively weak springs; those using percussion caps have blunt strikers with powerful springs.

Although positioned above ground, stake mines are easily camouflaged among vegetation and soon become overgrown. Since the mine may not be visible, the reliable location of tripwires is a priority for deminers.

Operational details

Typical operation

The fuze and detonator assembly are normally fitted into the top of the mine, and one or more anchored tripwires are attached to the striker retaining pin. The mine is then armed by the removal of a safety device; some incorporate a simple delay mechanism within the fuzing system to allow the setter time to leave the area safely before the mine becomes armed. After this, the mine is initiated when the striker retaining pin is removed by tension on the tripwire. Some striker retaining pins incorporate a small crimp or bend to increase the force required for extraction; this makes them safer to set up and less likely to be initiated prematurely (by falling twigs, small animals and so forth). Actuation of the fuze releases the striker onto a percussion or stab-sensitive detonator assembly and results in the immediate detonation of the main charge. The body is shattered, scattering fragments in all directions to a lethal radius typically between 10 and 20 m. The effective range is affected by the size of charge, thickness of casing and efficiency of fragmentation, but all produce a spread of fragments over a complete (360°) circle.

EOD considerations

- Procedures for the safe location of tripwires are critical, since stake mines are often concealed by vegetation
- Although initiation by tension-release is rare, taut tripwires should never be cut until both ends have been checked
- The thickness of the mine body (up to 20 mm in some cases) should be considered when selecting a demolition charge
- Since the explosive section of the mine is normally above ground, charge placement can be awkward
- During demolition, steps should be taken to minimise fragmentation if metal detectors are to be used in the area
- Since stake mines can be booby-trapped (see *Notes*), they should be pulled and not dismantled by hand.

Typical specifications

Example	Russian POMZ-2M	Yugoslav PMR-2A	Belgian NR-413
Fuze type:	MUV-type, tripwire	Enclosed striker, tripwire	Enclosed striker, four tripwire
Fragmentation:	Cast steel body	Cast steel body	Steel coil
Stake:	Wooden	Wooden	Steel
Diameter:	60 mm	66 mm	46 mm
Height (body):	107 mm	140 mm	114 mm
Weight:	1.8 kg	1.7 kg	640 g
Explosive weight:	75 g	100 g	100 g
Explosive type:	TNT	TNT	RDX/TNT
Operating force:	0.5–6 kg	3 kg	2–5 kg

Notes

Stake mines can be booby-trapped in a number of ways; for example, a buried grenade can be placed with the lever against the stake, or a pull wire may be connected to a buried fuze. In the Balkans, stakes have been hollowed out to accommodate an internal fuze. While internally grooved mine bodies normally fracture as intended along the weakened lines, those with external grooves tend to fragment very unevenly; large isolated fragments can inflict lethal or serious wounds at substantial distances. The production, use and transfer of anti-personnel mines is now prohibited under the Mine Ban Treaty (Ottawa Treaty). For more details on mines, refer to *Jane's Mines and Mine Clearance*.

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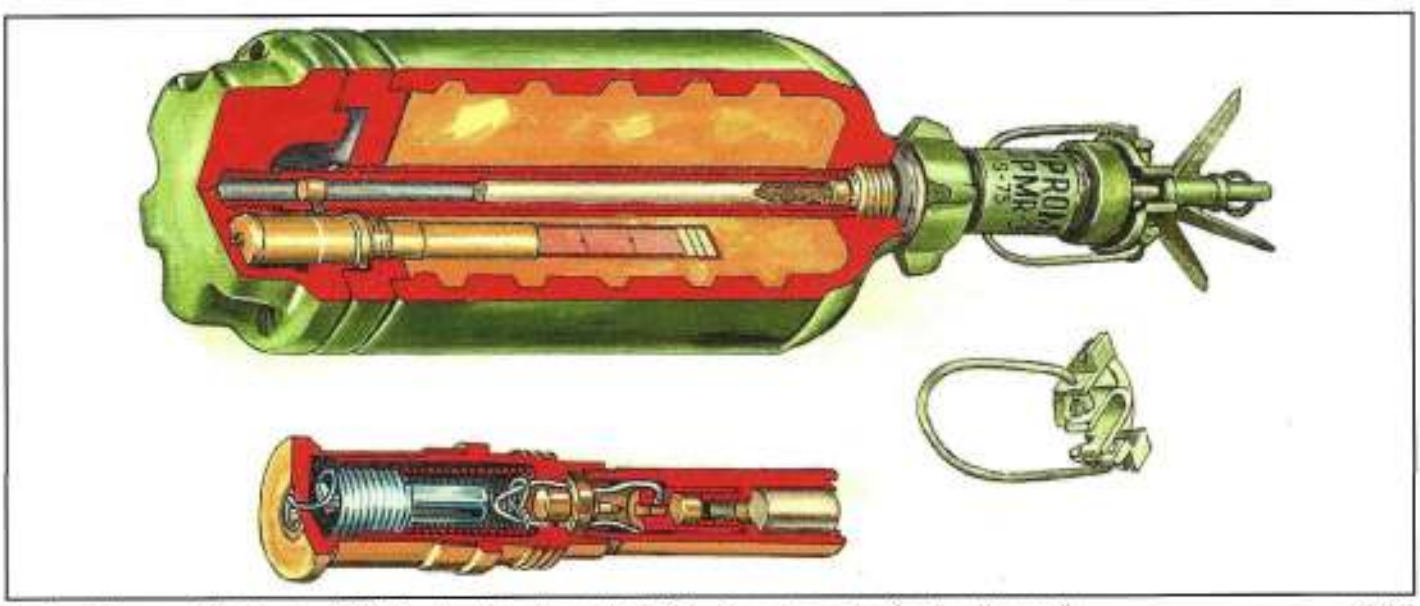
AP bounding fragmentation mines drawn to a common scale (Lyn Haywood) 0074201



Sectioned diagram of the Yugoslav PROM-1, with safety clip and detail of the internal secondary fuze (Lyn Haywood) 0021313

ANTI-PERSONNEL BOUNDING MINES

Description

The majority of Anti-Personnel (AP) bounding fragmentation mines are tripwire-operated, though several are also capable of pressure or electrical command initiation. The fuze of a bounding mine does not immediately detonate the main charge. Instead, it ignites a propellant which projects the mine body into the air; a second (internal) fuzing system, which may be either pyrotechnic or mechanical, then detonates the mine. A mechanical tripwire fuze or electric cable is inherently resistant to the effects of overpressure, and pressure fuzes tend to use prongs rather than pressure plates. These mines are therefore normally unaffected by explosive mine countermeasures, unless in close proximity. Since they are invariably buried, they are normally waterproofed. Other than one scatterable type (the US ADAM), all bounding mines are hand-emplaced.

The bodies of most AP bounding fragmentation mines are cylindrical, with the protruding fuze assembly mounted in the top surface. Some older types (such as the US M2 series) tended to mount the fuze to one side of the mine body. Older mines generally have cast-iron or steel bodies which are shattered to create shrapnel, but most modern designs use preformed fragments, often set into a plastic matrix. Several AP bounding fragmentation mines accept the same fuzes used with other types of AP fragmentation mine, though they are fitted with an igniter rather than a detonator. Fuzes generally have a safety device, often a second retaining pin, which must be removed in order to arm the mine. If electrically initiated, the mine may be used with any form of sensor package.

Operational details

Typical operation

Once the fuze assembly is in place and the mine has been buried, one or more anchored tripwires are attached, and the mine is armed by the removal of a safety device. Some fuzes, such as the Russian MUV-2, incorporate a delay mechanism to allow the setter to leave the area safely before the mine becomes armed. After this, the mine is initiated by tension on a tripwire, pressure or electrical command. Actuation of the fuze fires the igniter, which initiates the propellant charge; some igniters incorporate a short pyrotechnic delay to allow the victim to step off the mine before it functions. The propellant charge blows the mine body out of the ground, often leaving the outer casing in place.

When the mine body is well above ground level, typically 0.5 to 1.5 m, the main charge is detonated by the secondary fuzing system, scattering fragments in all directions. There are two main types of secondary fuzing system: the first uses a short pyrotechnic delay detonator, which is ignited by the burning propellant. The second uses a tether wire to connect a fuzing mechanism in the mine body with the base section that remains in the ground. This is a simple way of gauging the correct height of the mine for initiation; when the wire becomes taut, it operates the mechanical fuze to fire the detonator. The effective range (generally between 10 and 30 m) is influenced by the size of the charge, the height of detonation, the thickness of the casing and the efficiency of fragmentation, or the quantity of preformed fragments.

EOD considerations

- Several bounding mines can be initiated either by pressure or by tension on a tripwire
- Procedures to locate tripwires safely are critical, since bounding mines are rarely visible in minefields
- Although initiation by tension-release is rare, tripwires should always be traced to both ends before being cut
- Bounding mines are easily booby trapped using anti-lift devices
- Even with the external fuze neutralised, many bounding mines still contain a complete internal detonation train
- Most mechanical secondary (internal) fuzes use stab-sensitive detonators
- The thickness of the casing and fragmentation should be considered when selecting a demolition charge
- During demolition, steps should be taken to minimise fragmentation if metal detectors are to be used in the area.

Typical specifications

Example	Russian OZM-72	Italian V-69	Yugoslav PROM-1
Fuze type:	MUV-type, tripwire	Pronged, pressure/tripwire	Pronged, pressure/tripwire
Diameter:	106 mm	130 mm	75 mm
Height:	172 mm	205 mm	260 mm
Weight:	5 kg	3.2 kg	3 kg
Explosive weight:	500 g	420 g	425 g
Explosive type:	TNT	TNT/RDX	TNT/RDX
Operating force:	0.5–6 kg	10 kg pressure, 6 kg pull	9 kg pressure, 3 kg pull

Notes

Fragments from bounding mines often inflict lethal or serious wounds far beyond their quoted 'effective range'. Many fatalities have occurred during the removal, disarming and field disassembly of bounding mines. The production, use and transfer of anti-personnel mines is now prohibited under the Mine Ban Treaty (Ottawa Treaty). For more details on mines, refer to *Jane's Mines and Mine Clearance*.

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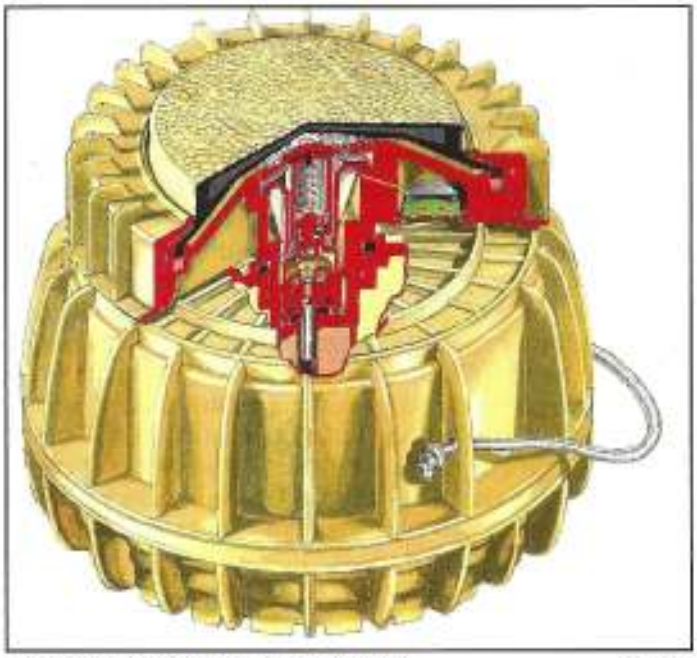
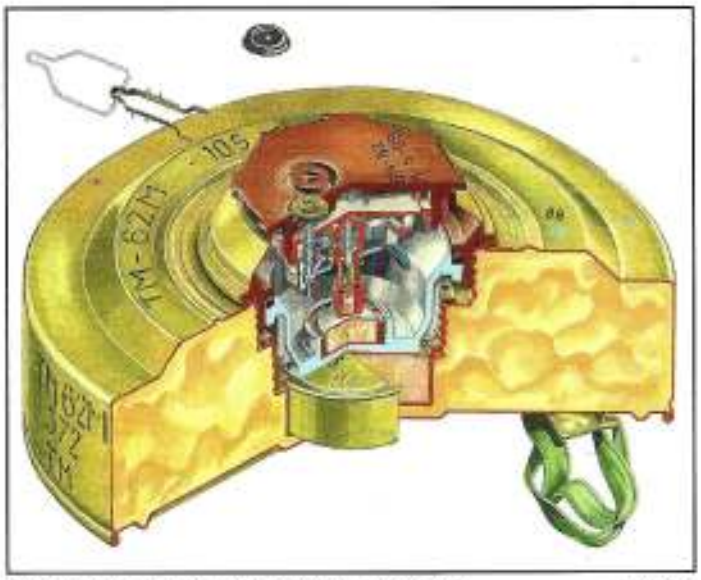
The Italian TC/6 mine, which is highly blast-resistant (Colin King) 0021161



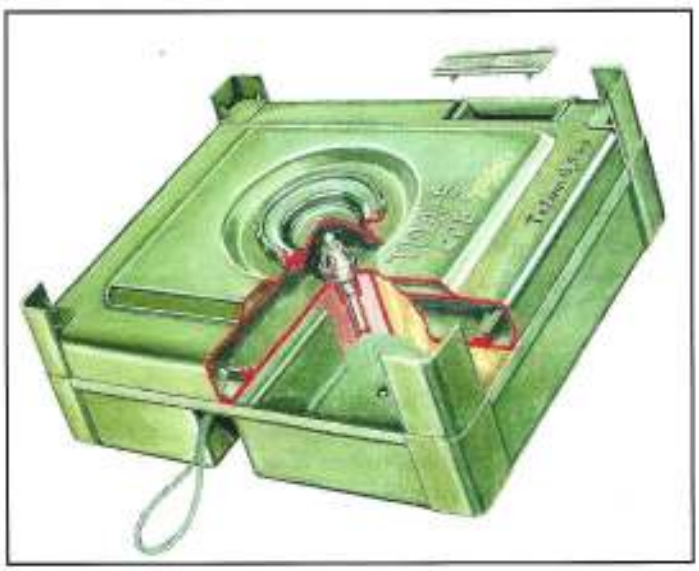
Cutaway diagram of the TC/6 (Lyn Haywood) 0021332

The Russian TM-62M, with mechanical fuze (Colin King) 0021204



Sectioned diagram of the TM-62M (Lyn Haywood) 0021315

The Yugoslav TMA-5A is a minimum-metal mine (Colin King) 0021261



Cutaway diagram of the TMA-5 (Lyn Haywood) 0021327

ANTI-TANK BLAST MINES

Description

Most Anti-Tank (AT) blast mines are pressure-operated, with a relatively simple mechanical fuzing system initiating a main charge housed in a thin outer casing. Many use TNT as the main charge, though some use more powerful explosives or mixtures, such as Composition B. Most of the more modern mines are waterproof, and many can be laid mechanically, some being scatterable. Plastic casings are widely used for ease of manufacture and resilience, though wooden and metal casings are common in older designs. Some AT blast mines are designed with a minimal metallic content in order to make detection more difficult, though most contain some metal. Shock-resistant fuzes are used in mines designed to be scattered, often giving the mine increased resistance to explosive mine countermeasures. The use of electronic fuzes is increasingly widespread among modern AT blast mines, though few have been used operationally. Booby-trapping AT mines is commonplace, and many are provided with auxiliary fuze wells for this purpose; electronic versions of some modern mines incorporate anti-handling features to discourage hand lifting.

Although there have been many variations, the configuration of the AT blast mine has been dictated largely by the requirement for efficient function combined with mechanical laying or scattering. Round mines are most common, generally with a pressure plate or fuze in the centre of the upper surface. Since the consequences of an accidental explosion are so serious, AT blast mines are invariably shipped without the fuze fitted, or with an element of the explosive train missing or out of alignment. Some mines accept a range of fuzing options, allowing the use of a tilt-rod fuze for full-width attack, or enabling an obsolescent mine to be upgraded with a modern electronic fuze, for example.

Operational details

Typical operation

After manual placement, the mine is armed by the insertion of the fuze assembly or the completion of the explosive train; some incorporate an arming delay within the fuzing system to allow the setter time to bury and camouflage the mine in safety. Scatterable mines are normally armed as they leave the dispenser and incorporate an arming delay or shock-resistant mechanism to prevent them from detonating on impact with the ground. Mechanically laid mines generally have an arming delay that is started as the mine is fed through the mine layer. Once armed, the mine is initiated when sufficient force is applied, via a pressure plate, to the fuze mechanism. With pressure fuzes, actuation normally results in the immediate detonation of the main charge; tilt-rod fuzes tend to incorporate a short delay to allow the target to move further over the mine. AT blast mines rely primarily on the shockwave produced by high-explosive detonation. Small mines tend to achieve 'mobility kills' on armoured vehicles by damaging tracks and running gear. Large mines may destroy the vehicle completely, particularly if they have been detonated beneath the hull by a full-width attack fuze. Even large armoured vehicles can be moved by the detonation of an AT mine, and this rapid displacement also tends to cause injuries to the crew.

EOD considerations

- Correct identification is important, since configurations and operating pressures vary substantially between different types
- Some tilt-rod fuzes require very little movement or force for initiation
- Minimum-metal precautions should be observed when approaching mines with magnetic influence fuzes
- Some magnetic influence fuzes are very sensitive to movement
- To avoid applying load to the pressure plate, conventional demolition charges are generally placed beside the mine
- Resilient plastic-cased mines, and those with large air voids, may require substantial charges to ensure destruction
- Burning often works well against mines with thin casings, and the use of flares or pyrotechnic torches should be considered.

Typical specifications

Example	Italian TC/6	Russian TM-62M	Yugoslav TMA-5
Metal content:	Low (approx 3 g)	High (more than 1 kg)	Very low (approx 1 g)
Length/Diameter:	270 mm	320 mm	300 mm
Height:	185 mm	128 mm	110 mm
Weight:	9.6 kg	9.5 kg	6.6 kg
Explosive weight:	6 kg	7.5 kg	5.5 kg
Explosive type:	TNT/RDX	TNT	TNT
Operating force:	180–310 kg	150–550 kg	100–300 kg

Notes

Most AT mines rely on the structure of the casing to protect the fuze and achieve an appropriate operating pressure. If part of the casing is damaged, missing or has seriously deteriorated, the mine may function under the weight of a person. Some tilt-rod and magnetic influence fuzes are also sensitive enough to be initiated accidentally by people: these may be considered illegal under the Mine Ban Treaty (Ottawa Treaty). For more details on mines, refer to *Jane's Mines and Mine Clearance*.

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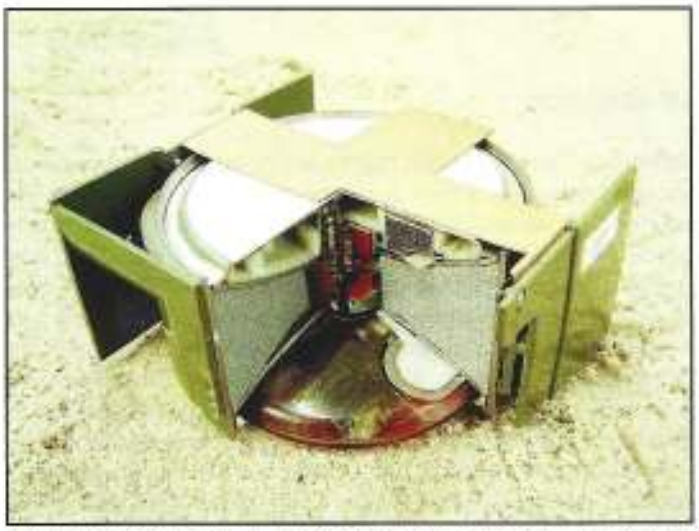
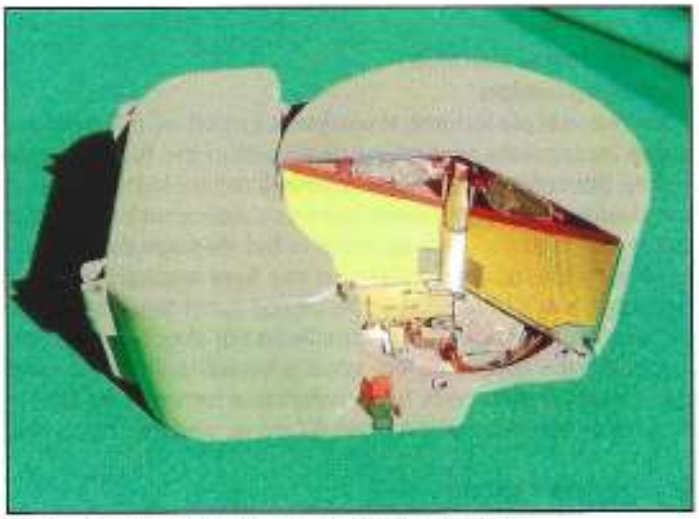
The US BLU-91/B 'Gator' is a scatterable shaped charge mine (Colin King) 0074605



A cutaway for the BLU-91/B shows an upper and lower MS plate, with the main charge sandwiched in between (Colin King) 1154108

The French HPD-F2 combines electronic fuzing with an MS warhead (Colin King) 0529197



Cutaway of the French HPD-F3, showing the MS warhead (Colin King) 1041202

The Yugoslav TMRP-6, which can be initiated either by pressure or by tilt-rod (Colin King) 0056097

The steel MS plate (arrow) is clearly visible in this cutaway TMRP-6 (Colin King) 0074008

ANTI-TANK SHAPED CHARGE MINES

Description

Shaped charge mines can be divided into those initiated beneath their target and those intended for 'stand-off' side or top attack; these are known as off-route mines and are dealt with separately. Anti-Tank Shaped Charge (ATSC) mines invariably use the Misznay Schardin (MS) principle to produce a self-forging fragment. Since the aim is to attack the belly of the vehicle rather than the running gear, ATSC mines have a Full-Width Attack Mine (FWAM) capability. In the past, this was achieved using a mechanical tilt-rod fuze, but modern mines use electronic sensors to combine high performance and concealment. Among the electronic fuzes, magnetic influence is the most common means of initiation, though seismic sensors are often used to alert the system and avoid unnecessary power drain. As with most modern mines, casings are normally plastic for ease of manufacture and durability; all ATSC mines have a high metal content and are therefore easily detectable. Small, lightweight scatterable ATSC mines incorporating electronics and high-performance explosives are becoming increasingly popular. Although expensive compared to simple blast mines, these are very versatile and cost-effective weapons.

The need to allow the MS warhead to function efficiently has dictated several configurations for ATSC mines. In some, such as the French HPD series, the fuze is set to one side of the MS plate, making the mine an irregular shape. In others, the fuze occupies a traditional central position on the top surface. Scatterable mines must either incorporate a mechanism (such as spring-loaded legs) to ensure they are correctly orientated after landing, or have multiple MS plates. The US M75 and BLU-91/B 'Gator', for example, have plates on the upper and lower surfaces, with the main charge sandwiched in between. Most modern mines use a small clearing charge to remove the top of the mine casing and surrounding debris before detonation, but some older models, such as the Russian TMK-2, use a protective dome, which results in a bulky mine with an odd profile. For mines with electrically powered fuzes, the battery compartment requires easy access; lithium batteries are generally used, giving the mine a maintenance-free lifespan of about 10 years. The US M75 and BLU-91/B 'Gator' use reserve batteries which are activated on deployment; these have the advantages of being safe in transit, and self-deactivating after a few weeks if the mine is not actuated. In some electronically fuzed mines, the options for sensitivity, selectivity, anti-handling, self-destruction or neutralisation have created a requirement for separate portable programming devices.

Operational details

Typical operation

Most shaped charge mines incorporate a safety feature, often in the form of an electronic or clockwork arming delay; for scatterable and mechanically-laid mines, this arming delay is started automatically during the laying process. In a mechanical mine, deflection of the tilt-rod initiates a short pyrotechnic delay to allow the target to move over the centre of the mine before detonation. In electronic fuzes, the seismic sensor detects the approach of a potential target and activates the magnetic influence sensor. When the electronic processor determines the optimum moment (normally as the target's centre of mass is overhead), the clearing charge is fired, and a fraction of a second later, the main charge is detonated to propel the MS plate upwards. The plate is forged into a high-velocity fragment, which penetrates the belly of the vehicle. The residual overpressure from the explosion enters the vehicle to kill or injure the crew and cause additional damage to the vehicle.

EOD considerations

- Correct identification is important, since configurations and operating pressures vary substantially
- Some tilt-rod fuzes require very little movement or force for initiation
- Minimum-metal precautions should be observed when approaching mines with magnetic influence fuzes
- Some magnetic influence fuzes are very sensitive to movement
- Mines with MS warheads generally have fuze components or voids at the top; they should be attacked from the side, if possible
- Burning is an effective demolition option for some thin-cased mines
- Precautions should be taken to arrest self-forging fragments from MS warheads.

Typical specifications

Example	French HPD-F3	US BLU-91/B 'Gator'	Yugoslav TMRP-6
Diameter/length:	278 mm	146 mm	290 mm
Height (mine body):	189 mm	66 mm	132 mm
Weight:	7.2 kg	1.95 kg	7.2 kg
Explosive weight:	3.3 kg	584 g	5.1 kg
Explosive type:	TNT/RDX	RDX/Estane (95/5)	TNT
Operating force:	Magnetic influence	Magnetic influence	150–360 kg pressure 1.5 kg on end of tilt rod
Penetration (armour):	150 mm	70 mm	40 mm

Notes

Some tilt-rod and magnetic influence fuzes are also sensitive enough to be initiated accidentally by people; these may be considered illegal under the Mine Ban Treaty (Ottawa Treaty). For more details on mines, refer to *Jane's Mines and Mine Clearance.*

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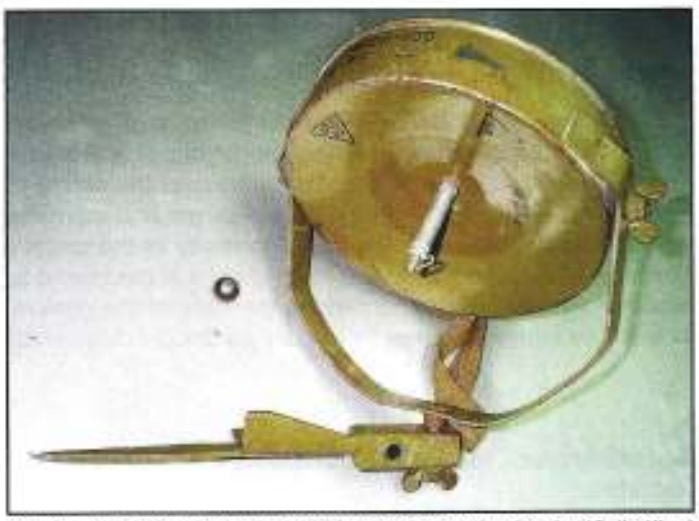
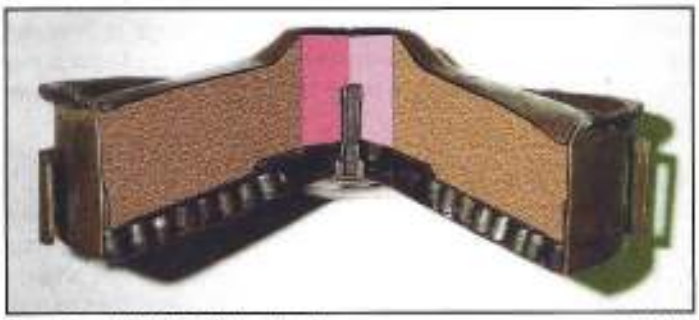
A Russian MON-50 set up for both tripwire and electrical command initiation (Colin King) 0021175

Cutaway diagram of the MON-50 (Lyn Haywood) 0021301

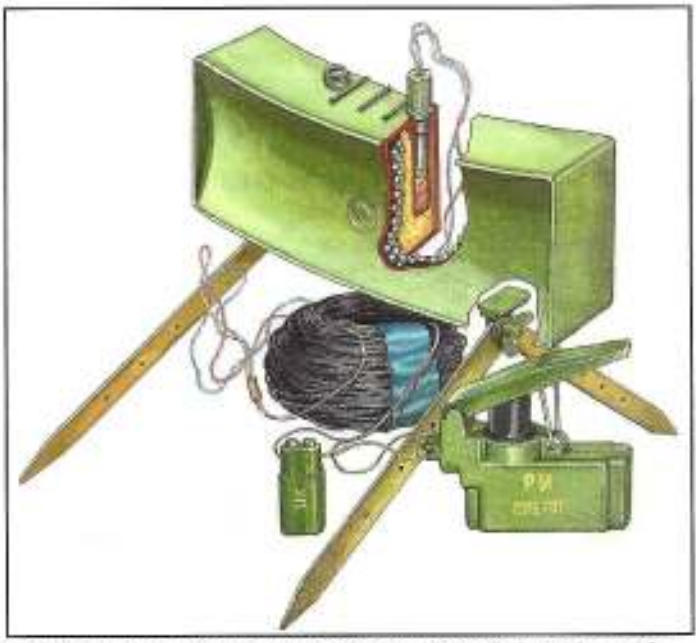


Russian MON-100 fitted with MUV fuze and mounting bracket (Colin King) 0056003



A sectioned MON-100 (Colin King) 1310183

Yugoslav MRUD, set up for electrical command initiation (Colin King) 0074901



Cutaway diagram of the MRUD with firing cable, exploder and test unit (Lyn Haywood) 0021300

DIRECTIONAL FRAGMENTATION MINES

Description

The majority of directional fragmentation mines were originally designed to be either tripwire-operated or electrically command-initiated. The use of plastic explosive is widespread, though some of the larger mines still use TNT as the main charge. The fragmentation in directional mines is normally preformed as ball-bearings or chopped steel rod; this may be set into a resin matrix or arranged between two thin sheets of the casing. Mechanical tripwire fuzes and electrical cables are inherently resistant to the effects of overpressure and therefore are normally unaffected by explosive mine countermeasures, unless in close proximity. Directional fragmentation mines are almost always mounted above ground to maximise their range and effect; most are supplied with legs or mounting brackets for fixing to trees. Since the orientation of a directional mine is critical, they must be emplaced manually. In addition to their anti-personnel role, the power and fragment size of the larger mines makes them effective against soft-skinned and lightly armoured vehicles.

There are two types of directional fragmentation mine. The first type is the rectangular 'Claymore'; the shrapnel is normally arranged against a convex front face, and one or two detonator wells are moulded into the top surface or back. The second type is round, with a concave front face and a central detonator well. In both cases, the main charge is positioned behind the fragmentation, across the full width of the mine. The sizes of directional fragmentation mines vary considerably, and they are often locally manufactured or improvised in the field from readily available materials. Larger 'Claymore' types tend to have two detonator wells, while some round varieties have a hole right through the centre, allowing initiators to be inserted from the front or back. Initiation may be electrical, mechanical or explosive (using detonating cord); some mines allow a combination of methods.

Operational details

Typical operation

Electrical: The detonator is fitted into the mine, the cable is laid and the circuit is tested for continuity. The mine is normally command-initiated using either a battery pack or a hand-operated dynamo. Victim-actuated electronic fuzes incorporating sensors can be used, but this is rare.

Mechanical: Once the fuze and detonator assembly are in place, an anchored tripwire is laid within the mine's arc of fire. The fuze is then armed by the removal of a safety device; some fuzes incorporate an arming delay. After this, the mine is initiated by tension on the tripwire.

Explosive: Detonating cord is run directly into the fuze well. By running detonating cord out of the second fuze well, several mines can be linked together for simultaneous detonation.

Actuation of the fuzing system results in the immediate detonation of the main charge, projecting fragments in a well-defined pattern. Lethal ranges are substantial (typically about 50 m) and danger areas may extend to hundreds of metres. The effective range is largely determined by the size of charge, the quantity of fragmentation and the tightness of the shrapnel pattern. Rectangular 'Claymore' types produce a horizontal fan of fragments (normally over an arc of about 60°), while round mines create a narrow cone of shrapnel, similar to the spread of pellets from a shotgun.

EOD considerations

- Although initiation by tension-release is rare, tripwires should always be traced to both ends before being cut
- Because they are positioned above ground, in-place demolition of directional mines can be awkward
- During demolition, steps should be taken to minimise fragmentation if metal detectors are to be used in the area
- Where possible, directional mines should be placed face down, and charges should be placed against the thin rear surface
- Command-initiated mines should be isolated from any electrical source before neutralising or disarming
- Directional mines are sometimes 'daisy-chained' together, or connected to larger charges
- Fragments from directional mines can inflict lethal or serious injuries well beyond their quoted 'effective range'.

Typical specifications

Example	Russian MON-50	Russian MON-100	Yugoslav MRUD
Body shape:	Rectangular	Round	Rectangular
Length/diameter:	226 mm	236 mm	231 mm
Height (body):	156 mm	236 mm	89 mm
Weight:	2 kg	5 kg	1.5 kg
Explosive weight:	700 g	2 kg	900 g
Explosive type:	RDX-based plastic	TNT	PETN or RDX-based plastic
Lethal range:	50 m	100 m	50 m

Notes

Many countries have restricted their directional mines to command-initiation types and have categorised them as 'other devices' (rather than mines) for the purposes of the Mine Ban Treaty (Ottawa Treaty). Directional mines that use victim-actuated fuzes are illegal under the Treaty. For more details on mines, refer to *Jane's Mines and Mine Clearance.*

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The German PARM DM-12 has a purpose-built HEAT warhead 0074009

The Russian TM-83 uses a large Misznay Schardin plate for armour penetration. The mine is alerted by a seismic sensor and initiated by the IR sensor that is mounted above the warhead (Colin King) 0056185

Many of the HEAT off-route mines fire anti-tank rockets such as this one, a Brazilian copy of the US M28A2 used in the M24 mine
(Colin King)
0018953

The French MIACAH F1 off-route mine was designated L27 in the UK. It was dropped from service because its sensitive breakwire fuze does not comply with the terms of the Mine Ban Treaty (Colin King) 0673783

OFF-ROUTE MINES

Description

Off-route mines are designed for positioning to one side of the target's path, several metres away from the point of attack. They must have clear line of sight to the target (other than light vegetation or camouflage) and are therefore normally mounted above the ground on a tripod or frame. To allow the mine to function as a stand-alone weapon, it is normally set up to be actuated by its target, but since most are electrically fuzed, remote command initiation is also possible. The majority are battery powered and therefore have a fairly limited active period, unless they are initiated using a remote power source (such as a battery pack or dynamo). First-generation off-route mines used electric 'breakwire' or tripwire for initiation, but modern versions tend to use sensors combined with electronics to increase accuracy and versatility. Off-route mines are generally more complex and expensive than other types of mine and, because they are dependent on a number of variable factors, tend to achieve less consistent results.

Two kinds of warhead are used in off-route mines. In the first type, a High Explosive Anti-Tank (HEAT) warhead is projected (normally by a rocket) at its target; the warhead detonates on impact with the target and uses the 'Munroe effect' of the shaped charge to defeat the armour. These mines sometimes use an adapted shoulder-launched Light Anti-tank Weapon (LAW), combined with a purpose-built mounting frame, sight and fuzing system. The second type uses a Misznay Schardin (MS) warhead, which projects a high-velocity self-forging fragment at the target when detonated. The majority of off-route mines attack the side of their target, but some new designs use top attack. These may either over-fly their target, or fire a spinning sublet above it; both techniques use MS plates in the warhead.

Operational details

Typical operation

After positioning and sighting in, the initiation system is set up and armed. Electronic fuzes may use a seismic or acoustic sensor to alert the system, with an Infra-Red (IR) sensor initiating the mine when the target enters its field of view. Contact sensors must be aligned with the warhead, completing the firing circuit when impacted by the target; in the case of breakwire, a collapsing circuit initiates the mine when the circuit around the wire is broken. As the target triggers the mine, the MS warhead is detonated or the HEAT warhead is launched. Detonation of the HEAT warhead occurs on impact with the target. Damage may be inflicted both by the penetrating jet of molten metal and by overpressure from the explosion. Because of its range from the target, damage from an MS warhead is inflicted solely by the energy of the self-forging fragment. The chances of a successful hit depend largely on the care with which the mine was set up, the range and the speed of the target vehicle.

EOD considerations

- Modern electronic off-route mines often incorporate anti-handling features
- Contact with the fuzing sensor, or entry into a sensor's field of view, may initiate the mine
- Electric wires and breakwire connected to the mine must not be cut; this may trigger a collapsing circuit
- Where a rocket is present, the demolition procedure must prevent accidental launch
- During demolition, the cone of a HEAT warhead should be crushed to prevent formation of a jet
- Precautions should be taken to arrest or prevent the formation of a self-forging fragment.

Typical specifications

Example	French MIACAH F1	German PARM DM-12	Russian TM-83
Effects:	Misznay Schardin	HEAT	Misznay Schardin
Length:	260 mm	640 mm	250 mm
Height:	200 mm	391 mm	440 mm
Weight:	12 kg	10 kg	20.4 kg
Explosive weight:	6.5 kg	1.4 kg	9.6 kg
Max range:	100 m	40 m	50 m
Armour penetration:	70 mm	600 mm	100 mm

Notes

The penetration of HEAT warheads is normally substantially greater than that of self-forging fragments (see Specifications), while the heat and overpressure normally result in additional destructive effects. The MS warhead produces a single dense fragment travelling at high speed. Without suitable precautions during demolition, this fragment will retain its lethality over a considerable distance (hundreds of metres). Some fuzes, such as those using breakwire, are sensitive enough to be initiated accidentally by people; these may be considered illegal under the Mine Ban Treaty (Ottawa Treaty). For more details on mines, refer to *Jane's Mines and Mine Clearance*.

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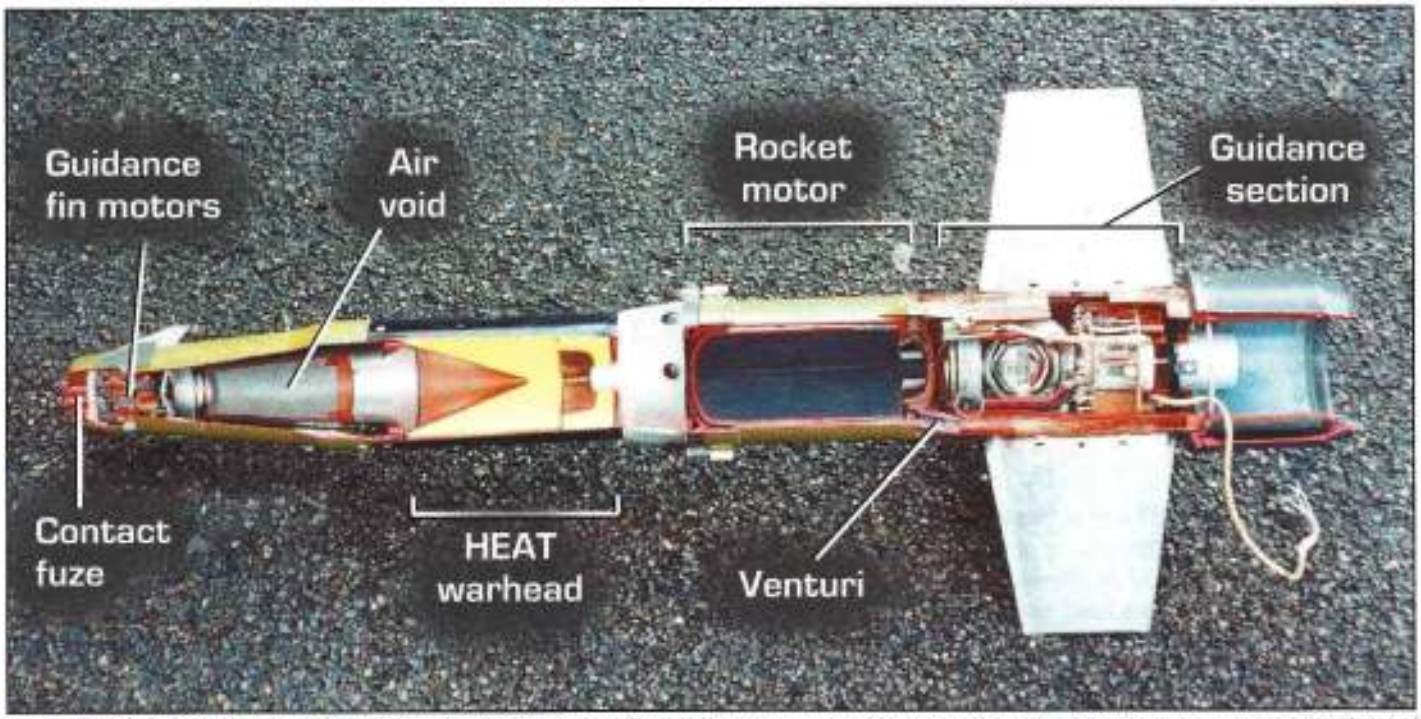
A Russian AT-4 ATGW. The location of key components in missiles is not always obvious. On close examination, venturis can be seen on the side of the casing, while the warhead is indicated by the Cyrillic 9N122M designation (Colin King) 0074282

Some large warheads and boosters are stored separately from the missile. These drums contain R550 'Magic' warheads (Colin King) 0573784

The Russian SA-6 has a solid propellant booster and ramjet sustainer motor (Colin King) 1121182

Anonymous crates containing SA-6 missiles (Colin King) 1121161



The AT-4 ATGW sectioned to show the location of major components. In this missile, note that the warhead and rocket motor are in the central section and that the venturi are ahead of the tailfins (Colin King) 1341677

MISSILES

GENERAL

Description

Missiles come in a vast range of sizes and functions, from shoulder-launched Surface-to-Air Missiles (SAM), sometimes known as MAN-Portable Air Defence Systems (MANPADS), to the large surface-to-surface ballistic missiles used to deliver nuclear warheads. The difference between rockets and missiles is that the latter incorporate guidance systems while the former are unguided. Unlike a rocket, where sub-assemblies such as the warhead, motor and fuze can usually be identified, the location of components within a missile can be difficult to establish. The guidance system is often located in the nose, with the warhead placed well back in the body of the weapon and having no distinctive shape. The warheads of larger missiles are sometimes shipped and stored separately, as are the large solid-fuel booster motors used to assist the launch. Where the base of a missile incorporates guidance or tracking components, the venturis of the rocket motor may be relocated to the side of the casing (in a similar way to the Russian PG-7 rocket). Although most missiles use solid propellant, some liquid-fuelled missiles still exist; these can be particularly dangerous and require special precautions (see *Liquid-fuelled missiles*). Many missiles have active fuzing systems with proximity sensors that must be avoided during reconnaissance and EOD action.

Operational details

Typical operation

In many cases, missiles are part of an integrated weapon system to locate, identify, designate and track a target; the missile is often, therefore, 'locked' on to its target even before it is launched. During flight, the missile may be guided in a number of different ways. Anti-Tank Guided Weapons (ATGW) are normally controlled by the firer or may 'ride' a laser beam projected onto the target. Most SAMs incorporate active or passive tracking systems and guide themselves, once locked onto a signal emitted or reflected from their designated target. Air-to-Air Missiles (AAM) and Air-to-Surface Missiles (ASM) may use either of these systems. With certain exceptions (such as early versions of the British Rapier SAM) missiles for use against aircraft are not expected to strike their target; they therefore use proximity fuzes instead of, or as well as, a contact fuze. Some of the SAMs can also be initiated on command from their guidance base station. Warheads are generally either HEAT or HE fragmentation, depending on the role of the weapon. Metal rods are used as projected fragments in some anti-aircraft missiles, while Misznay Schardin warheads are becoming more common in modern missiles.

EOD considerations

- It is important not to confuse a missile with a rocket during initial reconnaissance
- The location and function of proximity fuzes may not be immediately obvious
- Proximity fuzes must be approached from outside their field of view
- Contact fuzes may be incorporated into fins
- The location of explosive components should be verified before demolition
- During demolition, all explosive components must be attacked simultaneously
- Demolition procedures must destroy the venturi to prevent unfired missiles from being launched
- Unburned propellant may be capable of detonation under some circumstances
- Liquid propellants require special procedures and precautions.

Typical specifications

Type	SAM: Shoulder-launched: 'MANPADS'	SAM: Static or mobile	AAM	ASM	ATGW
Example:	Russian SA-14 'Gremlin'	Russian SA-6 'Gainful'	US AIM-7M 'Sparrow'	US AGM-65 A/B 'Maverick'	Russian AT-4 'Spigot'
Body diameter:	72 mm	335 mm	203 mm	305 mm	120 mm (warhead)
Length:	1.47 m	5.8 m	3.66 m	2.49 m	875 mm
Weight:	10.3 kg	630 kg	230 kg	210 kg	7.3 kg
Warhead weight:	1.15 kg	57 kg	39 kg	57 kg	2.5 kg
Warhead type:	HE frag	HE frag	HE frag	Shaped charge	HEAT
Fuzing:	Impact	Contact and proximity	Active radar	Impact	Impact

Notes

More detailed descriptions of the different missile types, along with missile identification charts, are available in separate entries in this section. See also the national production tables in the *Data summary* Section.

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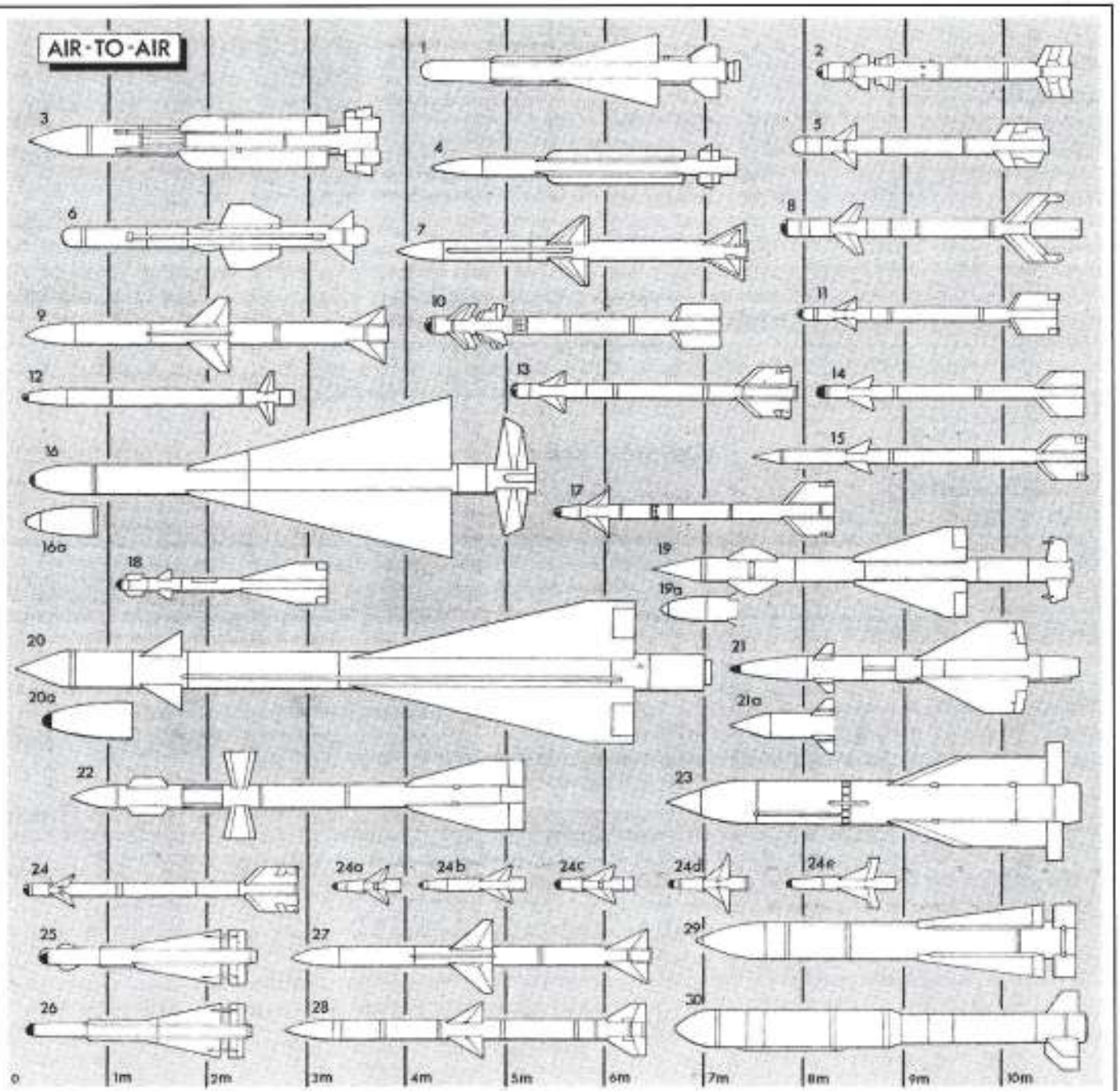
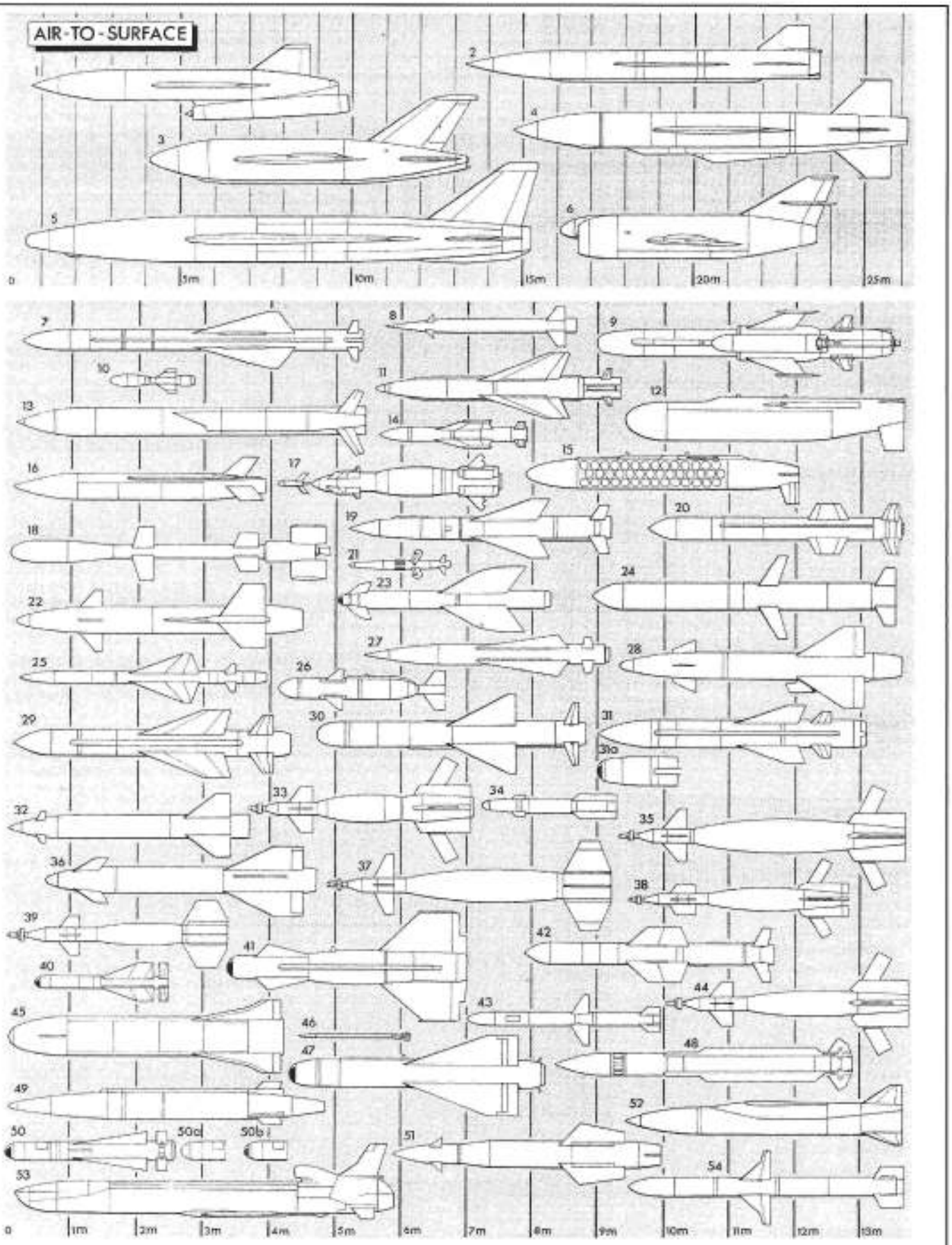
MISSILE IDENTIFICATION CHARTS



(1) R.530, **(2)** R.550 Magic, **(3)** Super 530, **(4)** Matra Mica, **(5)** Shafrir, **(6)** Red Top, **(7)** Aspide, **(8)** Python 3, **(9)** Sky Flash, **(10)** Kukri, **(11)** AAM-1, **(12)** ASRAAM (provisional), **(13)** MAA-1, **(14)** AA-2 Atoll, **(15)** Advanced Atoll, **(16)** AA-5 Ash (IR), **(16a)** AA-5 Ash (Radar), **(17)** PL-5B, **(18)** AA-8 Aphid, **(19)** AA-7 Apex (Radar), **(19a)** AA-7 Apex (IR), **(20)** AA-6 Acrid (Radar), **(20a)** AA-6 Acrid (IR), **(21)** AA-3 Anab (IR), **(21a)** AA-3 Anab (Radar), **(22)** AA-10, **(23)** AA-9, **(24)** AIM-9B Sidewinder, **(24a)** AIM-9D, **(24b)** AIM-9E, **(24c)** AIM-9H, **(24d)** AIM-9L, **(24e)** AIM-9N/P, **(25)** AIM-4G Falcon, **(26)** AIM-4G Super Falcon, **(27)** AIM-7E/F Sparrow III, **(28)** AIM-120 AMRAAM, **(29)** AIM-54C Phoenix, **(30)** ASAT

Air-to-air missiles

0074698



1 AS-2 Kipper, **2** AS-6 Kingfisher, **3** AS-5 Kelt, **4** AS-4 Kitchen, **5** AS-3 Kangaroo, **6** AS-1 Kennel, **7** Exocet AM 39, **8** Martin Pescador, **9** Otomat, **10** HOT, **11** AS-30 Laser, **12** Pegase, **13** ASMP, **14** AS. 15 TT, **15** CWS, **16** Apache, **17** Matra LGB, **18** Marte, **19** Kormoran Mk 1, **20** Gabriel Mk III, **21** RBS 70, **22** RB 04E, **23** Penguin Mk III, **24** Gabriel Long Range, **25** ALARM, **26** Sea Skua, **27** RB 05A, **28** RBS 15F, **29** Sea Eagle, **30** ASM-1, **31** Martel ARM, **31a** Martel TV, **32** AS-7 Kerry, **33** Paveway II (Mk 13/18), **34** Hellfire, **35** Paveway III (GBU-10), **36** AS-9, **37** Paveway I (GBU-10), **38** Paveway II (GBU-12B/B), **39** Paveway I (GBU-16), **40** Wasp, **41** GBU-15(V), **42** Harpoon, **43** Shrike, **44** Paveway II (GBU-16), **45** LAD, **46** HVM (provisional), **47** Walleye, **48** Standard ARM, **49** SRAM (AGM-69A), **50** Maverick (AGM-65B), **50a** Maverick Laser, **50b** Maverick IR, **51** Bullpup, **52** SRAM 2 (XAGM-131A—provisional), **53** ALCM, **54** HARM

Air-to-surface missiles

0129689

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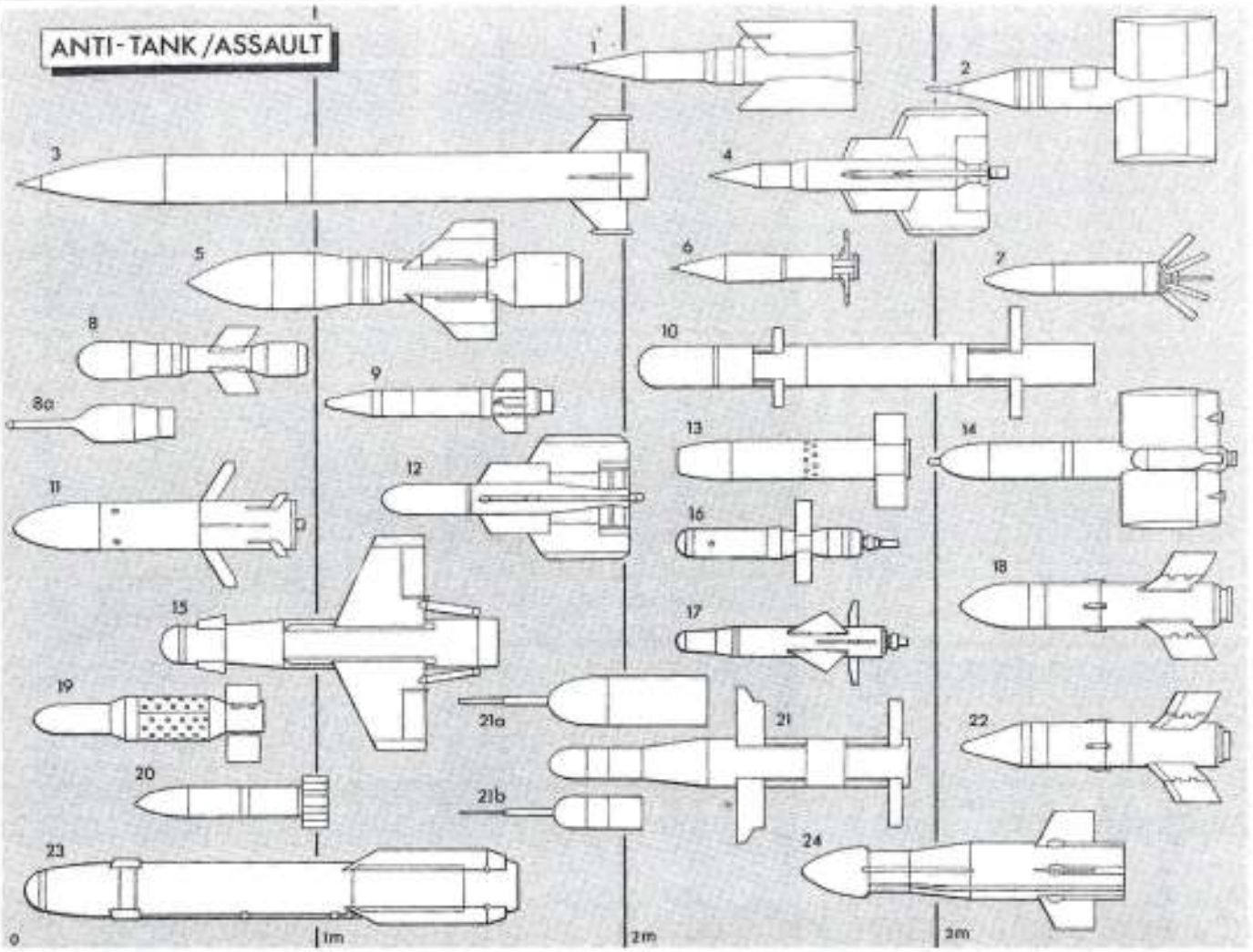
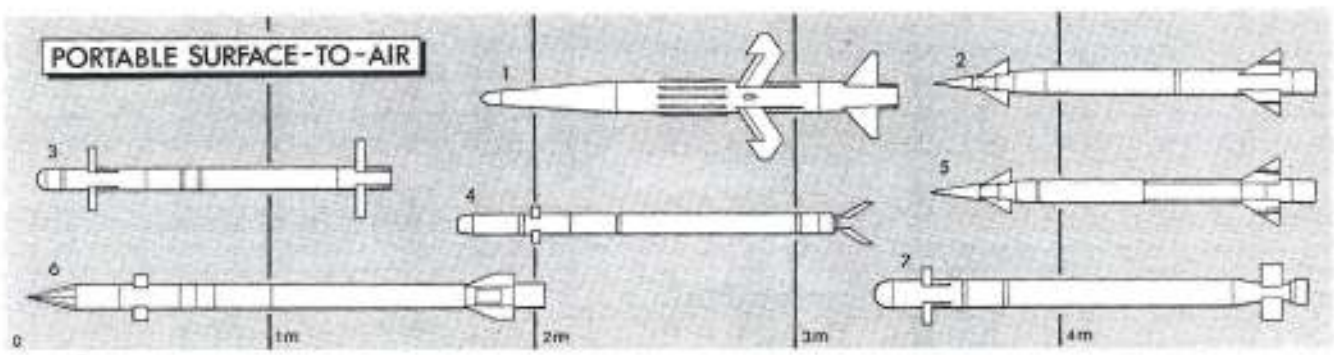


1 Mamba, **2** Cobra 2000, **3** ADATS, **4** Mathogo, **5** HOT, **6** ACL-STRIM, **7** Folgore, **8** MILAN, **8a** K115 long fuze MILAN version, **9** Picket, **10** KAM-9 (T79), **11** RBS 56 Bill, **12** Bantam, **13** Strix, **14** KAM-3D (T64), **15** AT-2 Swatter, **16** GAMP (Raytheon), **17** GAMP (General Dynamics), **18** Kun Wu, **19** Dragon, **20** LAW 80, **21** TOW, **21a** TOW 2, **21b** Improved TOW (ITOW), **22** AT-3 Sagger, **23** Hellfire, **24** Swingfire

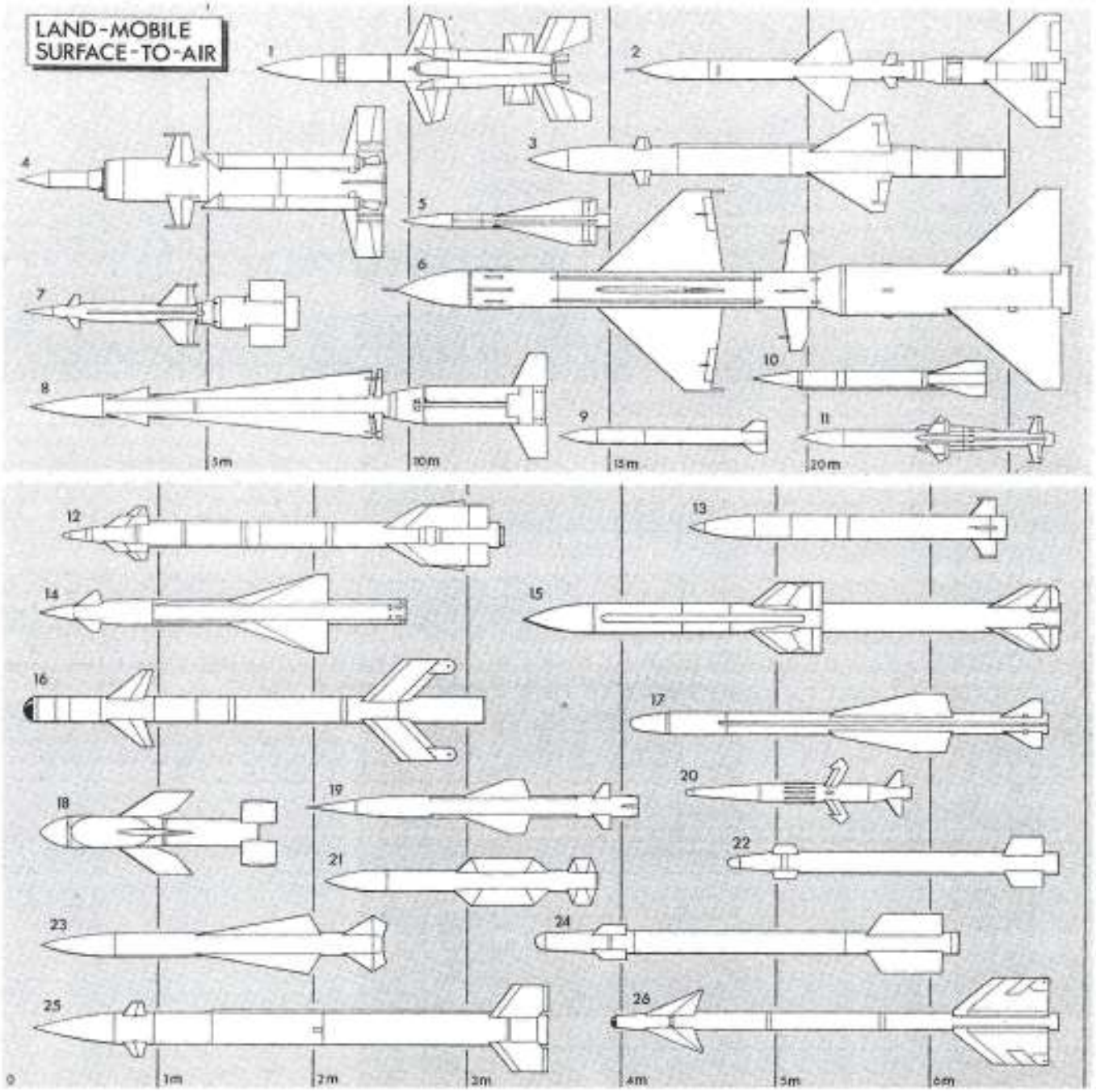
NOTE: This section of *Jane's Weapon Systems* concentrates mainly on anti-tank guided missiles. Details of additional unguided anti-tank weapons will be found in *Jane's Infantry Weapons* while details of artillery and armoured vehicle projectiles are given in *Jane's Armour and Artillery*.

Anti-tank guided missiles 0074700



1 RBS 70, **2** Blowpipe, **3** Redeye, **4** SA-7 Grail, **5** Javelin, **6** SATCP (Mistral), **7** Stinger

Portable surface-to-air missiles 0074701



1 Bloodhound, **2** Guideline (SA-2), **3** Guild (SA-1), **4** Ganef (SA-4), **5** I/HAWK, **6** Gammon (SA-5), **7** Goa (SA-3), **8** Nike Hercules, **9** Patriot, **10** Tien Kung Skybow 1, **11** Gainful (SA-6), **12** Crotale, **13** ADATS, **14** Roland, **15** Aspide (Spada), **16** Low Strike, **17** Tan-SAM (T81), **18** Tigercat, **19** Rapier, **20** RBS 70, **21** SA-11 (provisional), **22** SA-9 Gaskin (provisional), **23** SA-10 (provisional), **24** SA-13 (provisional), **25** SA-8 Gecko, **26** Chaparral

Mobile surface-to-air missiles

0074702

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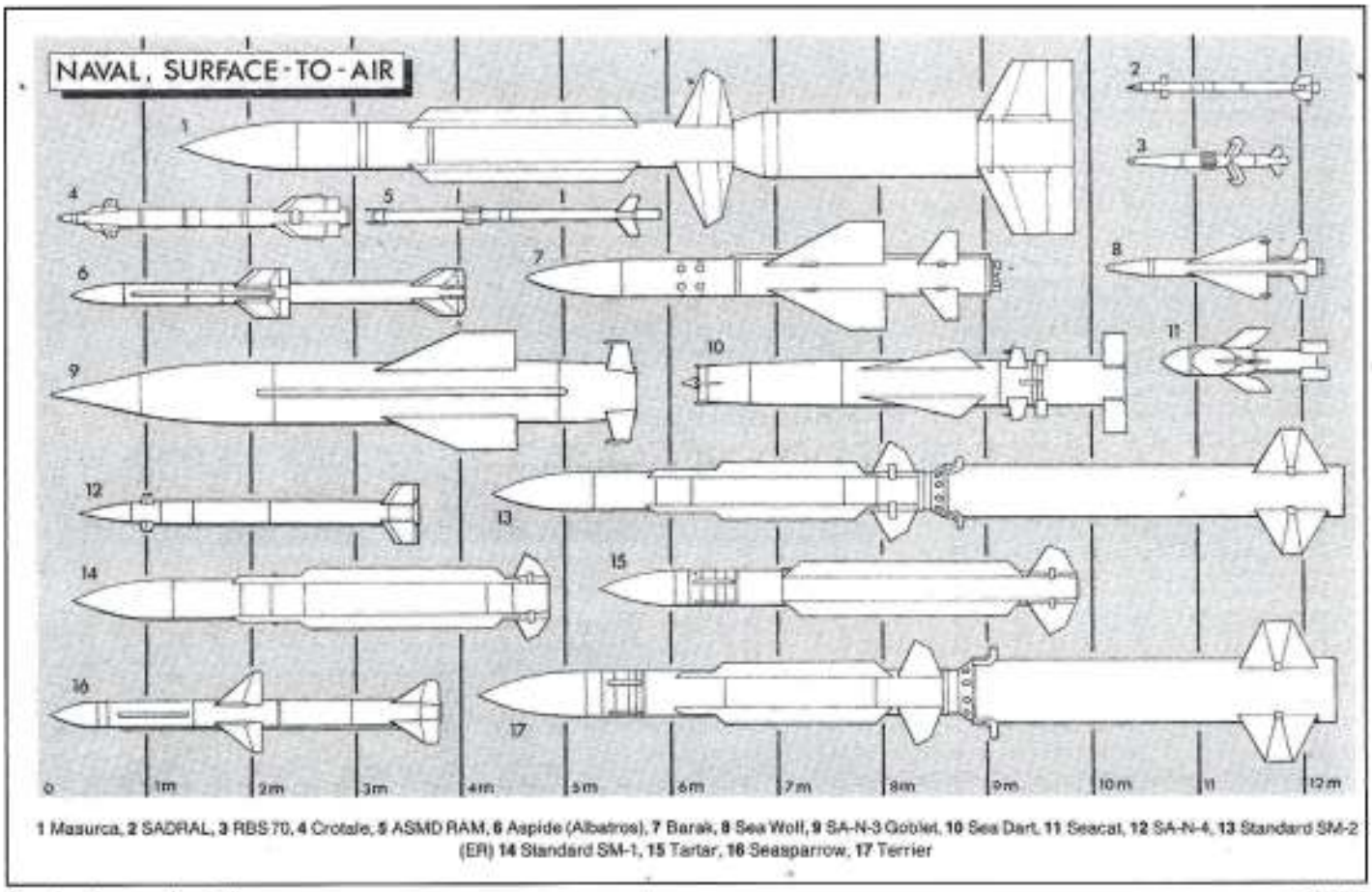
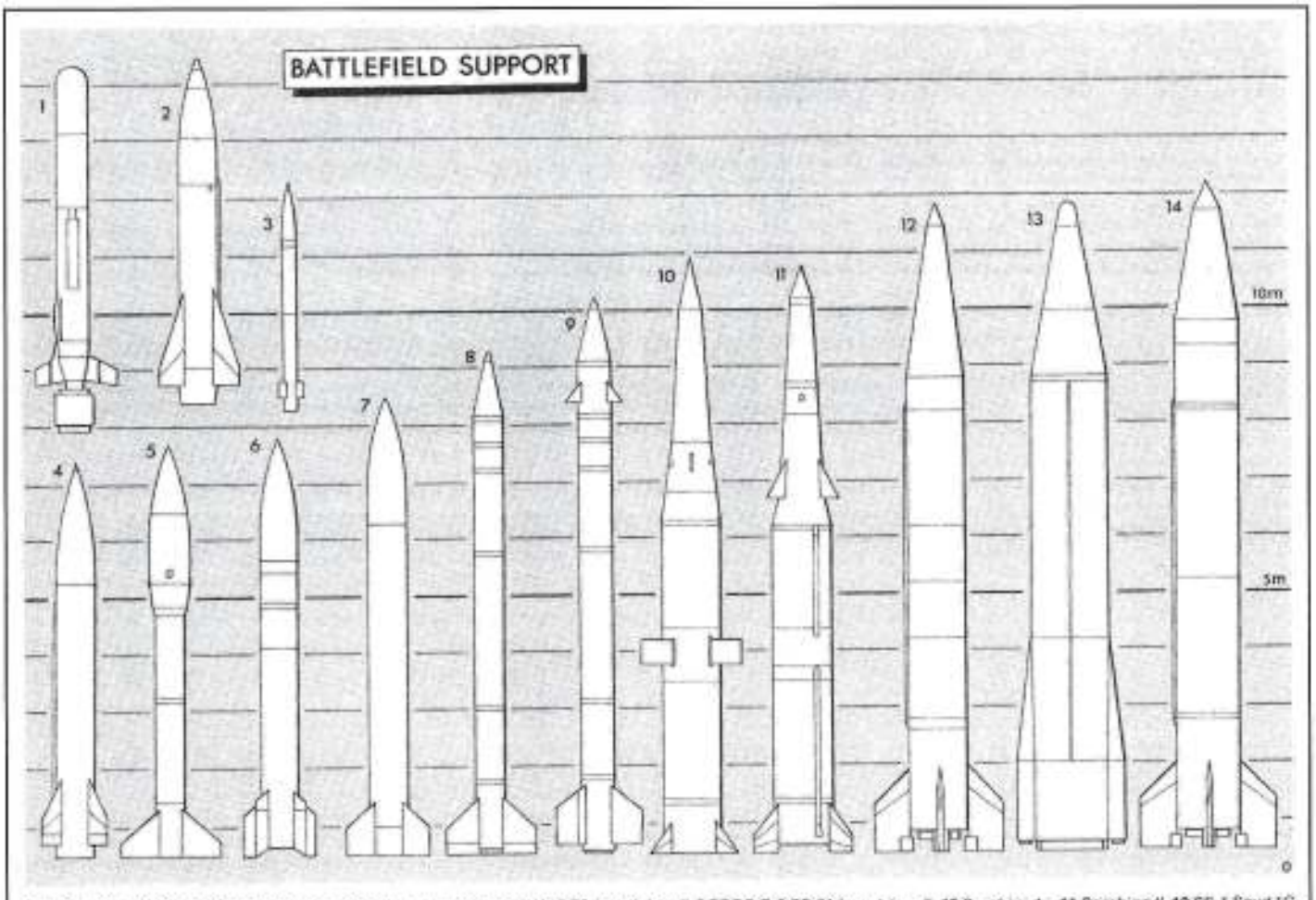


1 Masurca, **2** SADRAL, **3** RBS 70, **4** Crotale, **5** ASMD RAM, **6** Aspide (Albatros), **7** Barak, **8** Sea Wolf, **9** SA-N-3 Goblet, **10** Sea Dart, **11** Seacat, **12** SA-N-4, **13** Standard SM-2 (ER) **14** Standard SM-1, **15** Tartar, **16** Seasparrow, **17** Terrier

Naval surface-to-air missiles

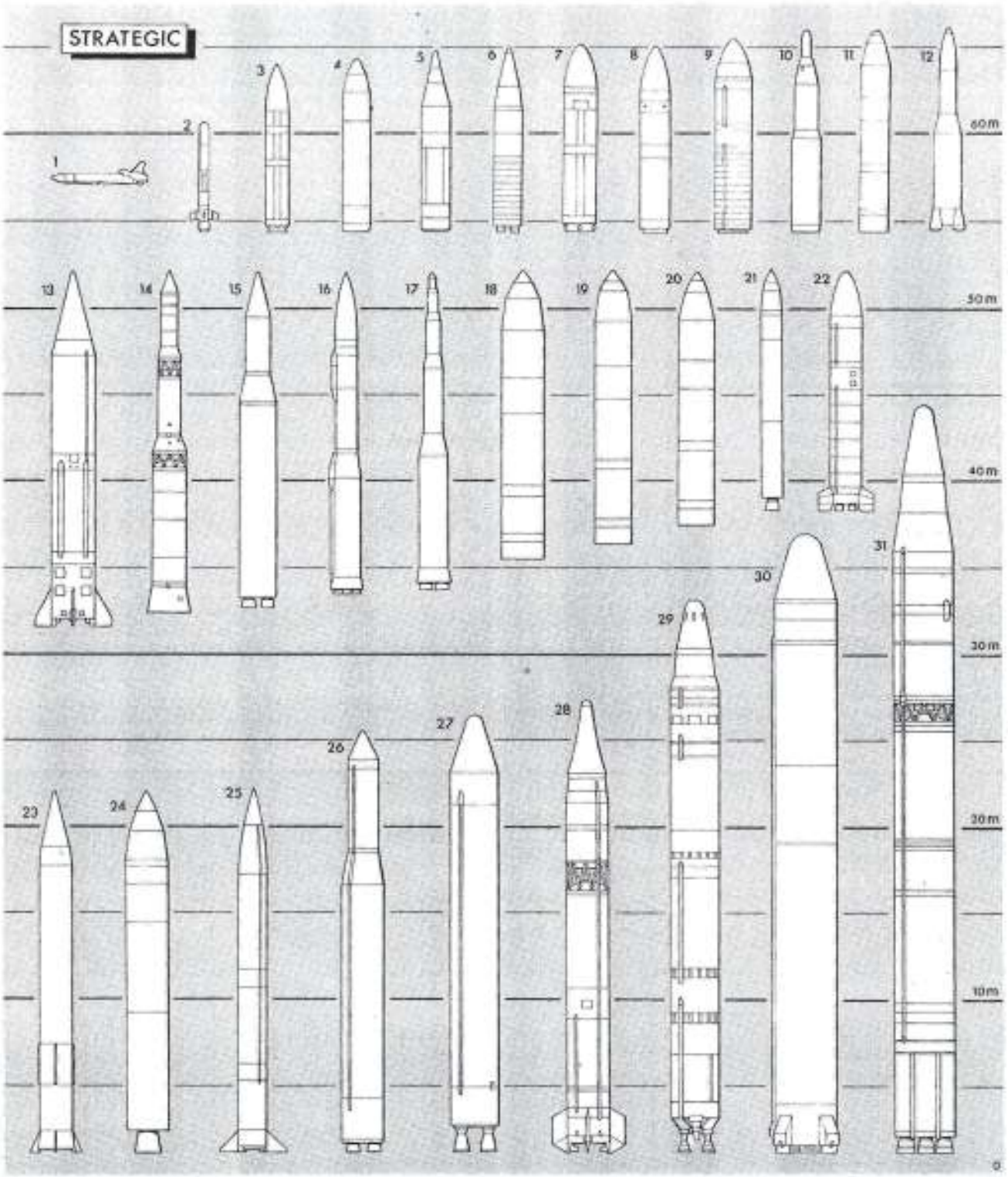
0074703



1 *GLCM*, **2** *Lance*, **3** *MLRS*, **4** *Ching Feng*, **5** *Honest John*, **6** *Pluton*, **7** *HADES (provisional)*, **8** *FROG-7*, **9** *SS-21 (provisional)*, **10** *Pershing 1a*, **11** *Pershing II*, **12** *SS-1 Scud 1C*, **13** *SS-12 (provisional)*, **14** *SS-22 (provisional)*

Battlefield surface-to-surface missiles

0074704



(1) ALCM, **(2)** GLCM, **(3)** Polaris A-3, **(4)** SS-N-6, **(5)** CSS-N-2, **(6)** MSBS (M20), **(7)** Trident C-4, **(8)** Poseidon C-3, **(9)** MSBS (M4), **(10)** SS-N-5, **(11)** SS-N-17, **(12)** SS-20 (provisional), **(13)** CSS-2, **(14)** SS-13 **(15)** SS-11, **(16)** Minuteman III, **(17)** Minuteman II, **(18)** SS-N-20, **(19)** SS-N-18, **(20)** SS-N-8, **(21)** Small ICBM, **(22)** SSBS, **(23)** SS-4, **(24)** Peacekeeper, **(25)** CSS-1, **(26)** SS-17, **(27)** SS-19, **(28)** CSS-3, **(29)** Titan II, **(30)** SS-18, **(31)** CSS-4

Strategic surface-to-surface missiles

0074705

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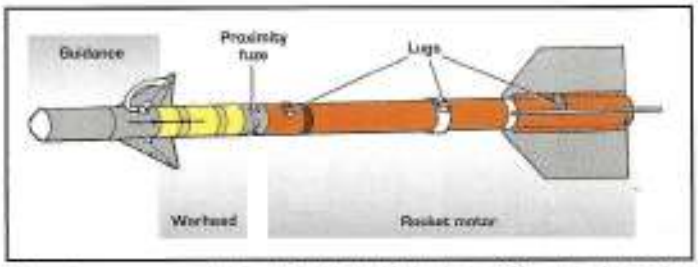
A demolished expanding rod warhead, typical of those used in air-to-air missiles (Colin King) 0532010

A cutaway of the AA-8 nose section, showing the hollow warhead encased in DU (Colin King) 1310398

The nose of a US AIM-9X AAM, showing the imaging IR seeker and active laser fuze windows (behind the fins) (Peter Humphris) 0103991



The major components of a US AIM-9M 'Sidewinder' (Colin King) 1341678

The Russian AA-8 warhead contains 1.6 kg of depleted uranium (Colin King) 0567410

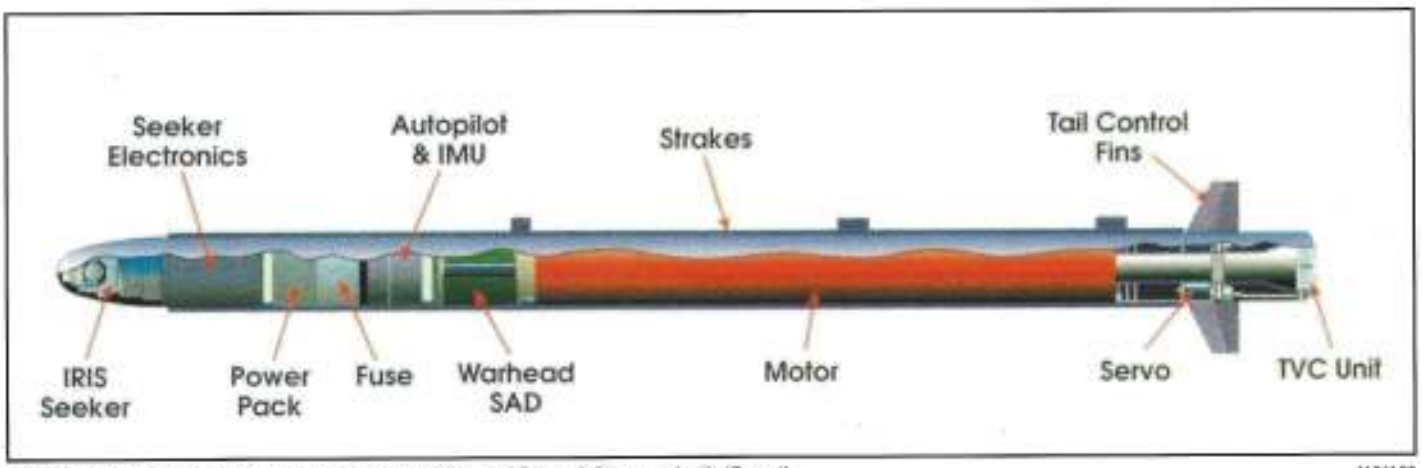


Diagram showing the main components of the South African A-Darter missile (Denel) 1121160

AIR-TO-AIR MISSILES

Description

With the exception of some older Russian designs, Air-to-Air Missiles (AAM) tend to have smaller diameter bodies than Air-to-Surface Missiles (ASM). Some shoulder-launched Surface-to-Air Missiles (such as the Russian SA-7) are also used in the AAM role, normally mounted on helicopters; these are covered in the SAM entry. All current AAM use solid propellant in their rocket motors. Some (such as the US Sidewinder) use single-stage motors, while others use a 'booster' rocket for initial acceleration, after which a slower-burning 'sustainer' motor takes over. Modern missiles may use composite propellants, in which oxidant and fuel, or HE particles, are bound into a polymer, such as HTPB (Hydroxy-Terminated Polybutadiene Binder). Most AAM use IR heat-seeking or radar guidance systems, which are generally mounted in the nose of the missile. AAM tend to rely primarily on proximity fuzes, with active radar fuzes steadily being replaced by active laser fuzes for most applications. Many contain additional impact fuzes or self-destruct devices. In order to detonate the warhead adjacent to the target, the proximity fuzes are generally sideways-looking; they consist of sets of windows in the casing, usually close to the warhead; one emits laser light while the other is a receiver. Early Russian versions of this system were similar in external appearance, but used the light emitted from electrical discharges. Fragmentation warheads normally use either steel cubes (from notched coils) or steel rods joined to form a concertina, known as 'continuous rod' or 'expanding rod' warheads. Some modern AAM now incorporate shaped or directional charges with high-performance explosives and may use other metals, such as titanium or tungsten alloy, for fragmentation. The Russian AA-8 (R-60T 'Aphid') is particularly noteworthy because the 3 kg warhead contains 1.6 kg of Depleted Uranium (DU) fragmentation. Secondary missile safety hazards include squibs, gas generators and high-pressure gas bottles.

Operational details

Typical operation

As the missile is launched, gas generators and thermal batteries are activated and the rocket motor ignited. Booster motors may be used for rapid initial acceleration; these burn violently for a very short duration. Since AAM require continuous thrust to reach their target, sustainer motors are used for the majority of the flight. Changes in direction are normally achieved either by movable fins (sometimes called canards) or by control vanes in the rocket motor efflux. Fins and vanes may be moved electrically or using pressurised gas from a bottle or a pyrotechnic gas generator. On detonation, fragmentation from AAM is generally designed to spread perpendicular to the direction of flight. In a continuous rod warhead, the concertina of steel rods forms an expanding circle, similar to a smoke ring, travelling along the missile's trajectory. Should the primary fuzing system fail to function before the missile reaches its effective range, the self-destruct delay should detonate the warhead.

EOD considerations

- Approaches to unexploded missiles must be from outside the field of view of any proximity sensor
- It is normal to approach from an angle towards the tail of the weapon
- The location of explosive components should be verified before demolition
- During demolition, all explosive components must be attacked simultaneously
- Demolition procedures must destroy the venturi to prevent rocket motors from launching
- Fragmentation warheads may have thick walls and require large demolition charges
- Unburned propellant may be capable of detonation under some circumstances
- Some missiles contain pyrotechnic gas generators or bottles under high pressure
- Special containment measures are required for the demolition of AA-8 warheads containing DU.

Typical specifications

Example	Russian AA-6 'Acrid'	Russian AA-8 (R-60T) 'Aphid'	US AIM-9M 'Sidewinder'
Type:	Long-range AAM	Short-range AAM	Short-range AAM
Body diameter:	355 mm	130 mm	127 mm
Length:	6.2 m	2.08 m	2.9 m
Weight:	467 kg	63 kg	86 kg
Warhead weight:	35 kg	3 kg	10.15 kg
Warhead type:	HE frag	DU fragmentation	HE frag
Fuzing:	Active laser proximity and radar	Active radar	Active laser proximity

Notes

See also *Air-to-air missiles – Russian designators* and the *Missile identification charts* in this section and the national production tables in the *Data summary* section.

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An IR-guided version of the Russian AA-6 'Acrid', one of the largest AAM. Note the sets of windows for the laser proximity fuze just forward of the tail fins. The strip between sets of windows is a radar fuze antenna (Christopher F Foss) 0022839

The Russian AA-10 'Alamo' (R-27R), which has an active radar fuze and 33 kg expanding rod warhead (Christopher F Foss) 0022844

AIR-TO-AIR MISSILES – RUSSIAN DESIGNATIONS

For diagrams, see the *Missile identification charts* in this section.

NATO Designator	NATO Nickname	Russian Designators	Type	Remarks
AA-1	Alkali	RS-1U, RS-2U, RS-2US, R-55	short-range, radio control	Fielded in the 1950s. Obsolete
AA-2	Atoll-B Atoll-C Atoll-D	R-13, R-3S R-3R, R-131 R-13M	short-range, IR and radar-guided	11.3 kg HE/frag warhead with contact or radar proximity fuzing. R-3S copied from US AIM-9B Sidewinder design. Widely exported and built under licence in China (PL-2/PL-3), India and Romania (A-91)
AA-3	Anab	R-8, R-30, R-98	medium-range, IR and radar-guided	All versions reported to have 40 kg HE blast warheads
AA-4	Awl	R-80R	n/k	
AA-5	Ash	R-4R, R-4R, R-4T	medium-range, IR and radar-guided	Both versions have 53.3 kg blast warheads
AA-6	Acrid	R-40R, R-40T, R-40RD, R-40TD	medium-range, IR and radar-guided	R-40T and R-46TD have 35 kg HE/frag warheads; R-40R and R-46RD have 55 kg HE/frag warheads. All use radar and active laser fuzing
AA-7	Apex	R-23R, R-23T, R-24R, R24T	medium-range, IR (R-24T) or radar-guided (R-24R)	35 kg HE/frag warhead with active radar fuzing. Built under licence in Romania (A-911). May have been built in other countries
AA-8	Aphid	R-60 (R-60T and R-60K), R-60M	short-range, IR	R-60 has active radar fuzing and a 3 kg HE/frag warhead containing 1.6 kg of DU. R-60M has HE/rod warhead and active laser fuzing. Exported to over 29 countries. Built under licence in Romania with designators A-95 and A-960
AA-9	Amos	R-33	long-range, radar-guided	47 kg HE/frag warhead with active radar fuzing.
AA-10	Alamo	R-27T, R-27R, R-27ET, R-27ER, R-27AE, R-27EM, R-27P, R-27EP	medium- and long-range, IR and radar-guided	All variants have expanding rod warheads (R-27T and R-27R: 33 kg, – R-27ET, R-27ER, R-27AE and R-27EM: 39 kg) and active radar fuzing. Reports of exports to 25 countries
AA-11	Archer	R-73M1, R-73M2, R-74	medium-range, IR guided	7.4 kg HE/rod warhead with active radar fuzing. Reports of exports to 26 countries. 100 missiles purchased by the USA in 1997 for evaluation
AA-12	Adder	R-77	medium-range, radar-guided	22 kg HE/frag warhead with active laser fuzing. Not yet in widespread service
AA-X-13		R-37	long-range, radar-guided	60 kg HE/frag warhead. Development of the AA-9, but with an active radar terminal seeker and longer range
The following shoulder-launched SAMs are also used in the AAM role				
SA-7a SA-7b	Grail	9M32 'Strela-2' 9M32 'Strela-2M'	short-range, IR	Warheads are 1.2 kg (SA-7a) and 1.8 kg (SA-7b); both are HE/frag with impact fuzing. Built under licence in Bulgaria, Czech Republic, Poland and the former Yugoslavia. China, Egypt, Romania, Pakistan, Poland and the former Yugoslavia have also built variants
SA-14	Gremlin	9M36 'Strela-3'	short-range, IR	2 kg HE/frag warhead with impact fuzing. Widely exported
SA-16	Gimlet	9M313 'Igla 1'	short-range, IR	2 kg HE/frag warhead with impact fuzing. Reported exported to 10 countries. Built under licence in Bulgaria. Unconfirmed reports that North Korea is building SA-16 missiles
SA-18	Grouse	9M39 'Igla'	short-range, IR	2 kg HE/frag warhead with impact fuzing. Reported exported to 10 countries. Built under licence in Bulgaria. Unconfirmed reports that North Korea is building SA-18 missiles

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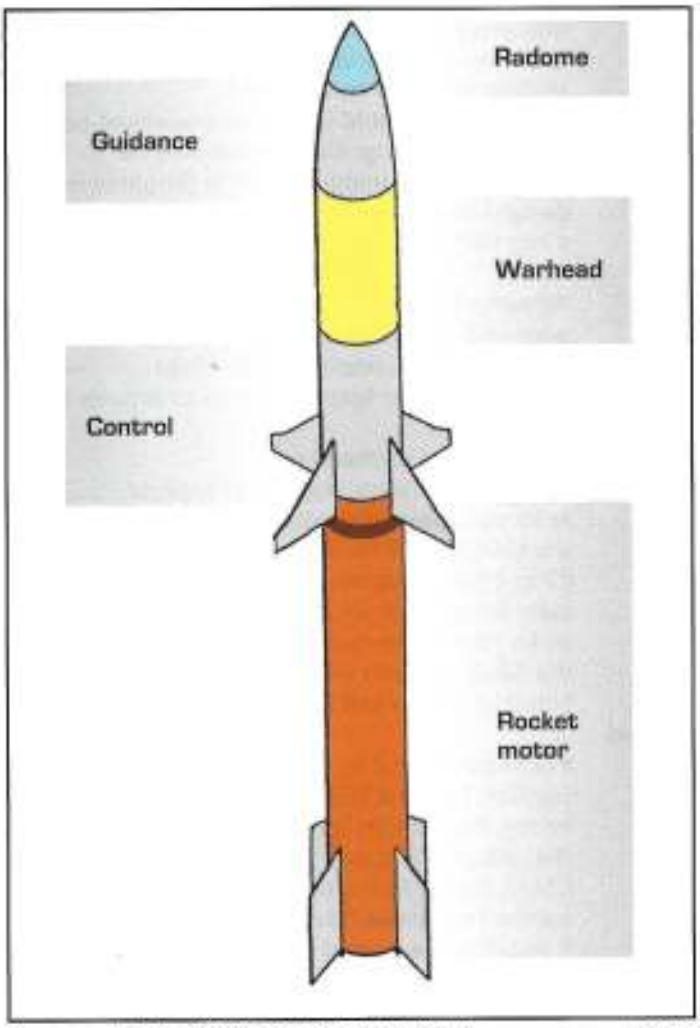
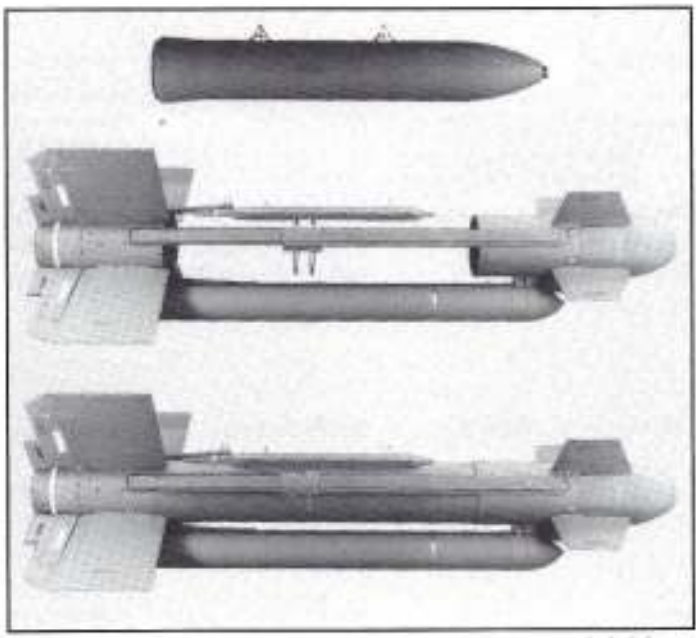
Training version of the US AGM-88 High-speed Anti-Radar Missile (HARM) (Jane's/Duncan Lennox) 0092770



Basic layout of the US AGM-88 HARM (Colin King) 1341679

Training version of the US AGM-130 missile (Boeing) 0016759



The AGM-130 consists of a BLU-109 penetration bomb in a guided airframe with a rocket motor 0504425

French AM 39 'Exocet' anti-ship missiles
(Jane's/Duncan Lennox)
0007750

AIR-TO-SURFACE MISSILES

Description

From an EOD perspective, Air-to-Surface Missiles (ASM) are broadly similar to Air-to-Air Missiles (AAM). The vast majority use solid propellant in rocket motors, although some ASM use jet engines and a few are still liquid fuelled. Modern missiles may use composite propellants, in which oxidant and fuel, or HE particles, are bound into a polymer, such as HTPB (Hydroxy-Terminated Polybutadiene Binder). A variety of guidance systems are used, depending on the role of the missile; these include TV, radio command, imaging IR, active and passive radar or laser, as well as more advanced systems incorporating terrain comparison and Global Positioning Systems (GPS). A number of ground-based Anti-Tank Guided Weapons (ATGW), such as the Russian AT-3 'Sagger' and US AGM-114 'Hellfire', are also used in the short-range air-to-surface role. In addition to deployment from helicopters, these are increasingly being fired from Unmanned Aerial Vehicles (UAVs). Many of the older ATGW are wire-guided using Manual Command to Line of Sight (MCLOS) or Semi-Automatic Command to Line of Sight (SACLOS) control systems, but newer types may be laser-designated or incorporate RF seekers. For more detail, see the separate entry on ATGW. Common ASM warheads include HEAT, tandem HEAT, blast, HE fragmentation and Semi-Armour-Piercing (SAP), with some missiles available with several warhead options. Thermobaric missiles, such as the AGM-114N, are also entering service. Some of the larger missiles incorporate off-the-shelf bomb bodies as warheads; examples include the US AGM-130 and Russian AS-14 Kedge, both of which use penetration bombs incorporated into a missile airframe. Some of the most modern types look more like small aircraft than missiles, with wings and fuselage designed to enhance their ability to glide. Impact fuzing is most common, often using a piezoelectric or crush switch, although modern missiles may use more advanced multi-option fuzes. Like other missiles, ASMs may incorporate secondary hazards such as spring-loaded fins, gas generators or high-pressure gas bottles.

Operational details

Typical operation

In a typical engagement, the target will be tracked and (where possible) the missile guidance will be locked on. On launching, thermal batteries and gas generators are activated and the rocket motors ignited. Most ASM use single-stage motors, but some have a 'booster' rocket for initial acceleration, after which a slower-burning 'sustainer' motor takes over. The missile may be guided to its target using its own active or passive homing system, or by command (MCLOS or SACLOS) from the aircraft. Changes in direction are normally achieved either by movable fins (sometimes called canards) or by control vanes in the rocket motor efflux. Fins and vanes may be moved electrically or using pressurised gas. Most ASM warheads detonate on impact; exceptions include fragmentation warheads and some shaped charges, which may incorporate proximity fuzes. SAP warheads incorporate a short delay in the fuze to allow the missile to penetrate the target. Some ASM have self-destruct delays that are designed to operate if the primary fuzing system fails to function.

EOD considerations

- Care must be taken to identify and avoid proximity sensors
- It is particularly important to take strict radio frequency precautions
- Unexploded missiles should be approached from an angle towards the tail of the weapon
- The location of explosive components should be verified before demolition
- During demolition, all explosive components must be attacked simultaneously
- Demolition procedures must destroy the venturi to prevent rocket motors from launching
- Fragmentation or SAP warheads may have thick walls and require large demolition charges
- Unburned propellant may be capable of detonation under some circumstances
- Liquid propellants require special procedures and precautions
- Some systems may contain pyrotechnic gas generators or bottles under high pressure.

Typical specifications

Example	French AM 39 'Exocet'	Russian AS-14 'Kedge' (Kh-29L)	US AGM-88 'HARM'
Role:	Anti-ship	Hard target penetration	Anti-radar
Body diameter:	350 mm	380 mm	254 mm
Length:	4.7 m	3.87 m	4.17 m
Weight:	670 kg	650 kg	361 kg
Warhead weight:	165 kg	317 kg	66 kg
Warhead type:	Shaped charge/fragmentation	HE blast	HE blast/fragmentation
Fuzing:	Active radar and impact	n/k	Active laser

Notes

See also the *Missile identification charts* in this section and the national production tables in the *Data summary* section.

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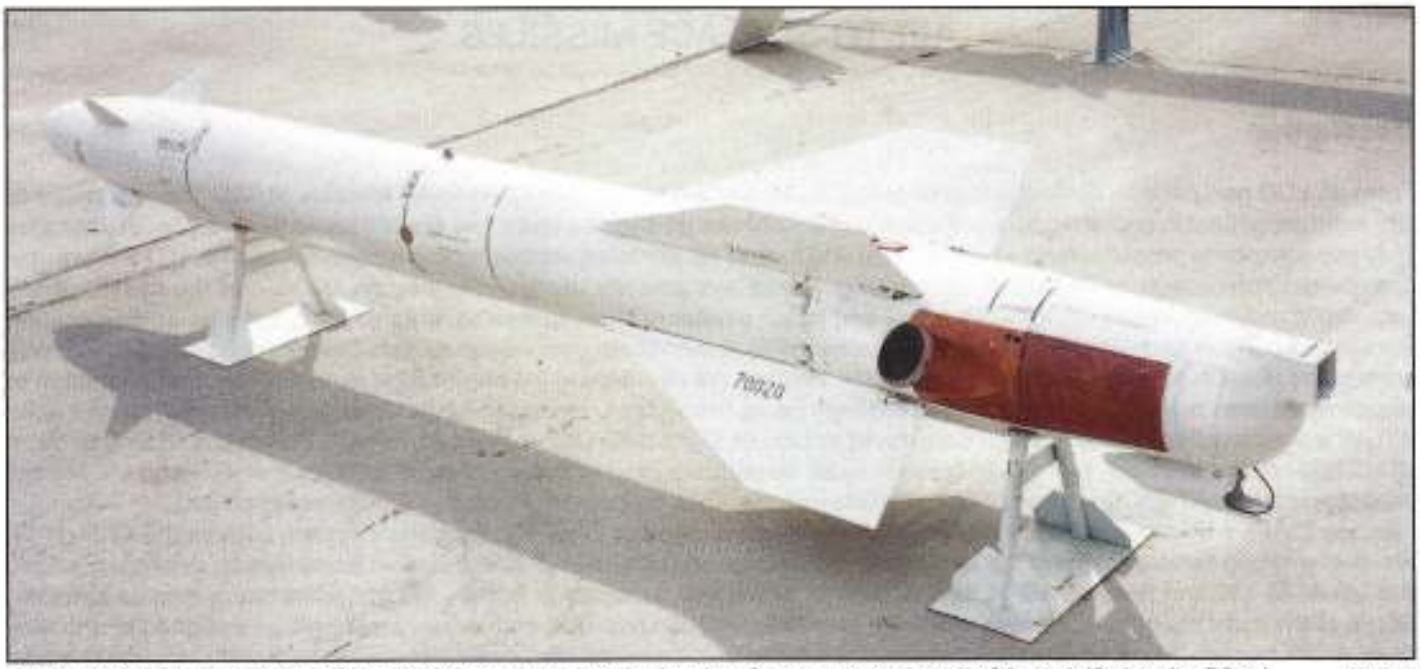

Russian Kh-25 MR (AS-10 'Karen') ASM with 140 kg warhead. Note the location of the venturi, on the side of the body (Christopher F Foss) 0064592

An AS-14 'Kedge' in Iraq. The warhead is a 317 kg penetration bomb (Colin King) 0673787

AIR-TO-SURFACE MISSILES – RUSSIAN DESIGNATORS

NATO Designator	Nickname	Russian Designators	Type	Remarks
AS-1	Kennel	KS, KS-1 'Kometa'	n/k	Introduced in 1953. Obsolete
AS-2	Kipper	K-10, K-10S	long-range, autopilot/ command guided	Obsolete. Carried a 1,000 kg HE or nuclear warhead
AS-3	Kangaroo	Kh-20	long-range, autopilot/ command guided	Obsolete. Carried a thermonuclear warhead
AS-4	Kitchen	Kh-22 'Burya'	long-range, radar- guided	930 kg HE (or 200 kT nuclear) warhead with active radar fuzing
AS-5	Kelt	KSR-2, KSR-11	long-range, radar terminal guidance	Obsolete liquid-fuelled missile with 1,000 kg HE warhead
AS-6	Kingfish	KSR-5/11 and Kh26	long-range, radar-guided	930 kg HE (or 350 kT nuclear) warhead
AS-7	Kerry	Kh-23, Kh-27, Kh-66 'Grom'	short-range, command-guided	103–108 kg shaped charge warhead with impact fuzing. Direct development of the Russian AA-1 'Alkali' design, using some components from the AA-3 'Anab'. Reported exported to 29 countries
AS-8	see *Remarks*	9K113 'Shturm-V'	short-range, radio command	Now known as AT-6 'Spiral'
AS-9	Kyle	Kh-28	medium-range, anti radar	200 kg HE/frag warhead. Reported exported to 13 countries
AS-10	Karen	Kh-25 MR, ML, MT, MTP and MA	short-range, radio command- or laser- guided	HE/frag warheads 86–140 kg, all with active radar fuzing. Reported exported to 18 countries Export versions believed referred to by the X-25 designator
AS-11	Kilter	Kh-58	medium-range, anti-radar	Nuclear or 149–152 kg HE/frag warhead with active radar fuzing. Reported exported to 9 countries
AS-12	Kegler	Kh-25 MP/Kh-27	medium-range, anti-radar	86 kg HE/frag warhead. Reported exported to 15 countries
AS-13	Kingbolt	Kh-59 'Ovod'	medium-range, TV command-guided	148 kg warhead. Limited export and deployment
AS-14	Kedge	Kh-29T, TE and L	medium-range, laser- or TV-guided	Warhead is a 317 kg penetrator bomb. Reported exported to 14 countries
AS-15	Kent	Kh-55/RKV-500/ Kh-65	long-range cruise missile	Warhead options include nuclear, 410 kg HE or submunitions
AS-16	Kickback	Kh15/RKV-500B	long-range, inertial- and radar-guided	Nuclear or 150 kg HE warhead options. Limited export and deployment
AS-17	Krypton	Kh-31/KR-1	medium-range, radar-guided	87 kg HE/frag or 95–110 kg shaped charge warhead options. A small number of improved Kh-31 missiles, designated KR-1, was exported to China where it is believed they will be built under licence
AS-18	Kazoo	Kh-59M 'Ovod-M'	long-range, TV command-guided	Warhead options include nuclear, 320 kg HE or 280 kg submunition load. Turbojet powered version of the AS-13 'Kingbolt'
AS-19	Koala	n/k	n/k	Also known as BL-10
AS-20/SS-N-25/SSC-6	Kayak	Kh-35/3M24/Kh-37	long-range, radar-guided	145 kg HE SAP warhead with impact fuzing. X-35 indicates export version. Variants include: ship-launched (SS-N-25 'Switchblade'/ 3M60 Uran) and ground-launched (SSC-6 'Stooge'/3K60 Bal)
ASM-MSS/ SS-N-22	Sunburn	Kh-41 'Moskit' (3M80 or P-270)	long-range, inertial- and radar-guided	320 kg HE/frag warhead with impact fuzing
AS-X-19	Koala	Kh-90 'Meteorit'	long-range, inertial-guided cruise missile	Carries two 90 kT nuclear warheads
S-25LD	n/k	n/k	short-range, semi-active laser guided	Based on S-25 unguided rocket. 155 kg penetration warhead

Notes

Several anti-tank guided missiles are also used in the air-to-surface role, including AT-2, AT-3, AT-6, AT-9, AT-12 and AT-16. For more details on these missiles, see *Anti-tank guided weapons* and *Anti-tank guided weapon designations.*

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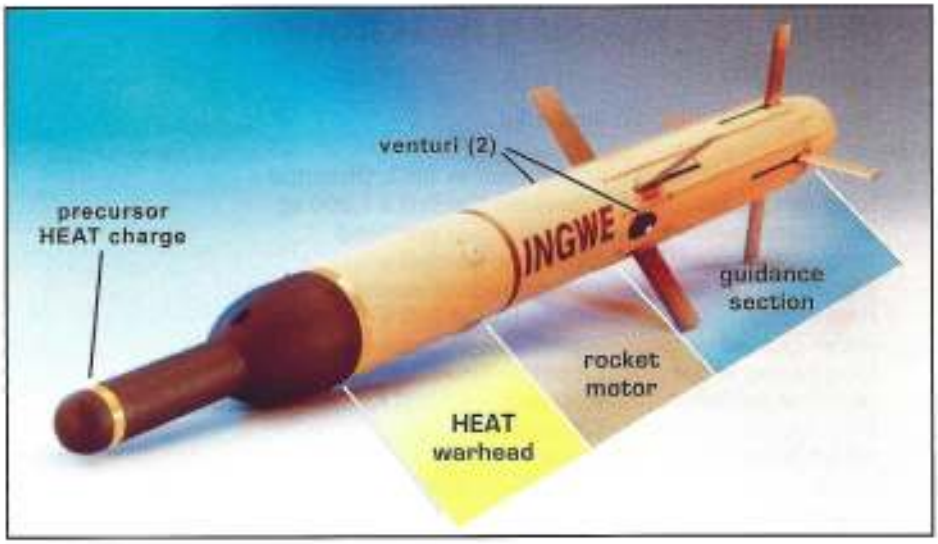
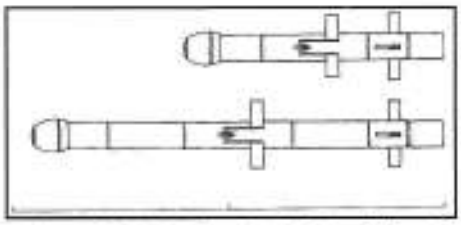
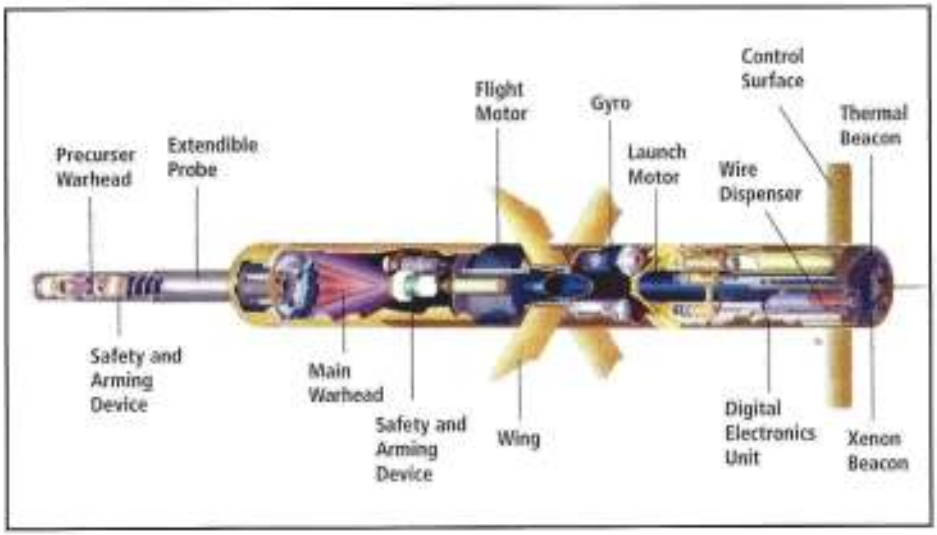


The South African 'Ingwe' is a laser-guided ATGW with tandem HEAT warhead (Kentron)
1310399

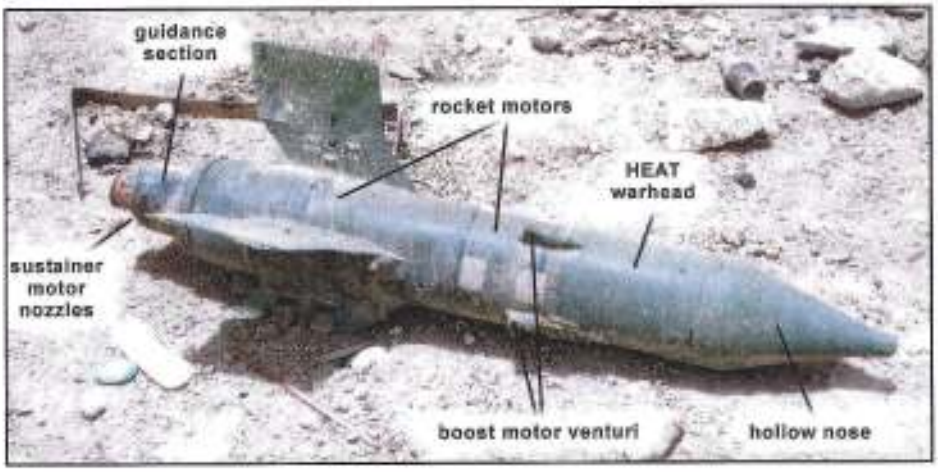


The Israeli Spike-LR (above) and Spike-ER (below)
0092775

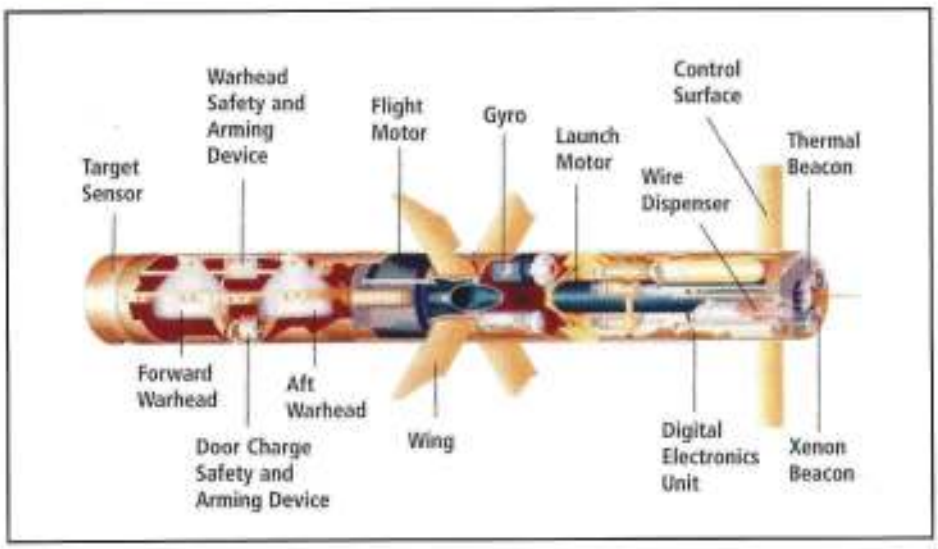


Cutaway diagram of the USTOW 2A showing the tandem HEAT warheads (Raytheon)
1121159

Sectioned US AGM-114 'Hellfire' missiles: HE frag (top), tandem HEAT (centre), tandem HEAT 'longbow' version (bottom)
(Jane's/Duncan Lennox) 0054583



The Russian AT-3 'Sagger' is one of the most common ATGW
(Colin King)
0573791



Cutaway diagram of the USTOW 2B showing the top attack MS warheads
(Raytheon)
1121158

Training version of the US M47 'Dragon' missile, designated FGM-77A (Colin King) 1341645

ANTI-TANK GUIDED WEAPONS

Description

Anti-Tank Guided Weapons (ATGW), also referred to as Anti-Tank Guided Missiles (ATGM), can be fired from man-portable launchers, armoured vehicles or helicopters; recently, ATGW have also been deployed from Unmanned Aerial Vehicles (UAVs). Although most are launched from dedicated firing posts or pods, some laser-guided ATGW can be fired from tank guns; before firing, these are very similar in appearance to normal projectiles. All ATGW rocket motors use solid propellant and many have side-mounted venturis, leaving the base free for guidance components; those with centrally mounted venturis generally have guidance components mounted in a pod at the side of the casing. The use of HEAT warheads is widespread; however, some weapons have several warhead options, and the position of the warhead can vary substantially between different missile types. The use of tandem HEAT warheads (to defeat Explosive Reactive Armour [ERA] and achieve greater penetration) is increasingly common, with some older types being retrofitted with the new warheads. Although most precursor charges are mounted on probes, and are therefore easily identified, some are incorporated into a normal nose profile. Some Russian and American ATGW, such as the AGM-114N 'Hellfire', now have optional 'thermobaric' (high blast fuel-air) warheads for attacking defensive positions and installations. Some of the latest missiles use 'top attack', overflying their target and firing one or more Misznay Schardin (MS) warheads downwards to penetrate the thin top armour. ATGW are normally fitted with piezoelectric or crush-impact fuzes, however, those designed for stand-off attack incorporate proximity fuzes, which may look forwards or downwards. ATGW tend to use thermal batteries and gas generators to provide power during their flight; some also contain small bottles of pressurised gas.

Operational details

Typical operation

Early missiles were directly controlled by the firer during flight, this system being known as Manual Command to Line of Sight (MCLOS). Newer systems merely require the firer to maintain the weapon sights on target, automatically sending guidance signals to the missile; this is Semi-Automatic Command to Line Of Sight (SACLOS). Most ATGW are fitted with tracking flares or modulated electric beacons so that the firer and/or the system can identify their position. Guidance signals are generally transmitted down wires, which unwind from spools in the tail of the missile, although laser guidance is increasingly common. Laser-guided missiles are sometimes known as 'beam riders', as they follow the path of a beam directed at the target from the firing post or vehicle; as mentioned above, some of these can be 'tube-launched' from tank guns. Newer 'fire and forget' missiles, such as 'Hellfire', use laser or RF seekers, rather than riding a beam. Changes in direction are normally achieved either by movable fins (sometimes called canards) or by control vanes in the rocket motor efflux. Fins and vanes may be moved electrically or using pressurised gas. The US 'Dragon' series of ATGW is unique in using small propellant charges, arranged around the side of the casing, to alter course. Most systems incorporate a self-destruct feature, which is designed to operate after a short delay should the impact fuze fail to function.

EOD considerations

- Partially impacted crush or piezoelectric fuzes may be in a highly sensitive condition
- Some newer ATGW incorporate forward or downward-looking proximity fuzes
- The location of explosive components should be verified before demolition
- The possible presence of MS or tandem HEAT warheads should be considered
- Demolition procedures must destroy the venturi to prevent unfired missiles from being launched
- Warhead destruction should prevent the formation of HEAT jets and MS plates
- Unburned propellant may be capable of detonation under some circumstances
- Some systems may contain gas generators or bottles under high pressure
- Unfired tube-launched ATGW are easily confused with projectiles.

Typical specifications

Example	Russian AT-3 'Sagger'	Israeli Spike-LR	US AGM-114L (Longbow Hellfire 2)
Guidance:	MCLOS, wire-guided	TV/Imaging IR	Inertial and RF
Warhead diameter:	125 mm	135 mm	150 mm
Length:	860 mm	1.2 m	1.78 m
Weight:	10.9 kg	11 kg	50 kg
Warhead weight:	2.6 kg	3 kg	12.5 kg (est)
Warhead type:	HEAT	Tandem HEAT	Tandem HEAT
Fuzing:	Impact	Impact	Impact

Notes

'Sagger', 'TOW' and 'Red Arrow' have variants with different warhead options and specifications; these are among the most common ATGW, and are used throughout the world. For more images, and details of non-NATO ATGW, see *Anti-tank guided weapon designations*. See also the *Missile identification charts* in this section and the national production tables in the *Data summary* section.

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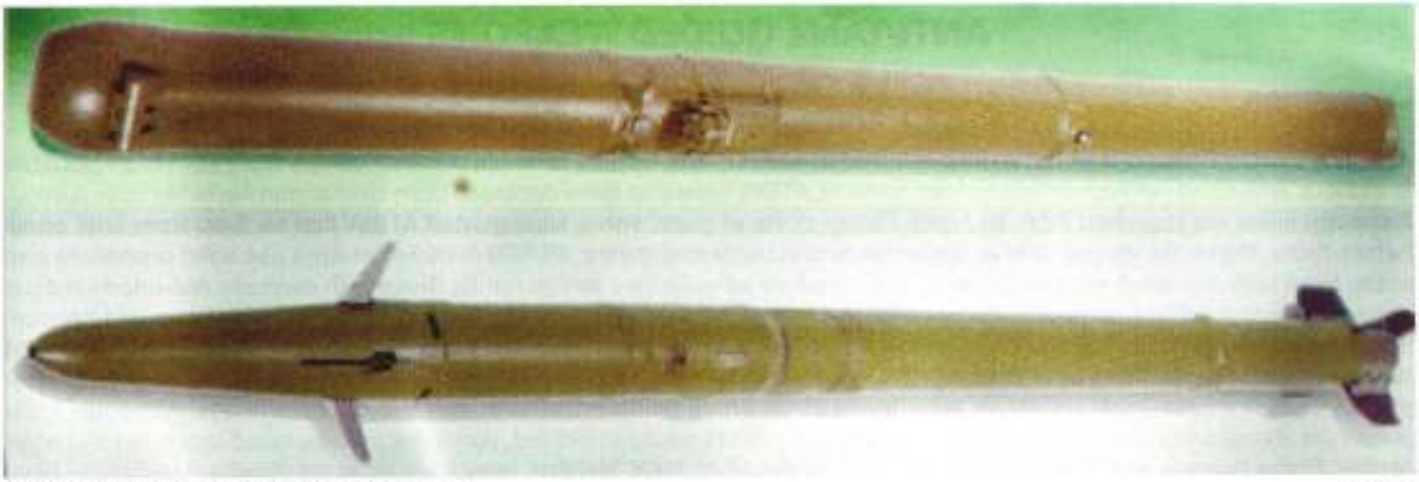
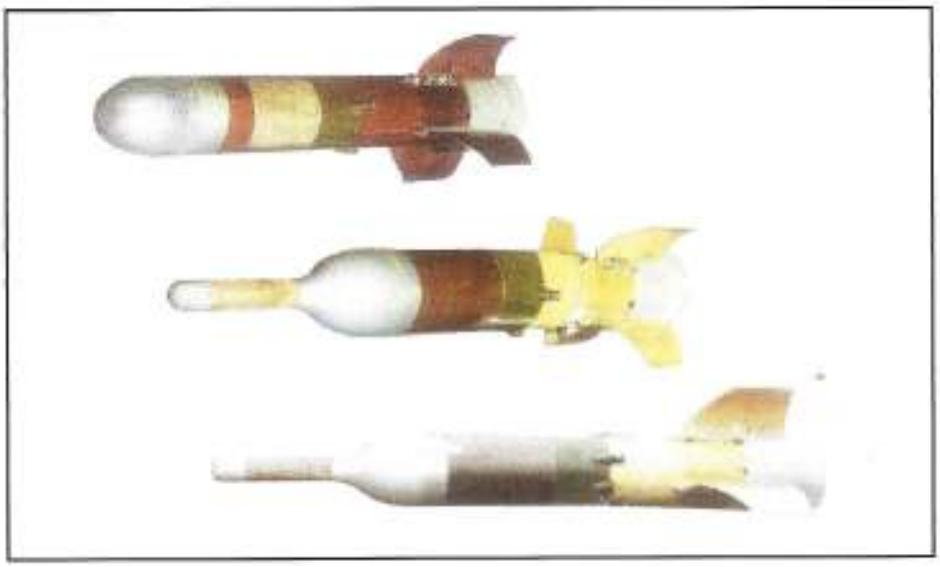


Russian AT-16 'Vikhr-M' missile and canister (KBP)
0016747



The crates in which 'Sagger' missiles are packed
(Colin King)
1041030

Chinese Red Arrow missiles, from the top: 8A (HEAT), 8C (Tandem HEAT), 8E (Tandem HEAT)
0014346

The Iranian I-RAAD missile is based on the AT-3, and has a tandem HEAT warhead
(T J Gander)
0063250

Cutaway of the AT-11 Russian (9M119) 125 mm gun-launched missile. Note that the HEAT warhead is towards the rear of the body, behind the rocket motor
0005788

The AT-5 Russian (9K113) 'Konkurs' missile
(Jane's/Paul Jackson)
0024678

ANTI-TANK GUIDED WEAPON DESIGNATIONS

The following ATGW designators are used for missiles produced by non-NATO countries. For US missile designations, see the US weapon designations entry in the Identification section, and national production tables in separate sections.

Designation	Country	NATO designation and nickname	Guidance	Remarks
3M6 'Shmel'	Russia	AT-1 'Snapper'	Wire	HEAT warhead, large fins. Obsolete
9M112 'Kobra'	Russia	AT-8 'Songster'	Radio	125 mm gun-launched missile with HEAT warhead
9M14 'Malyutka' series	Russia, Bulgaria, Iran, former Yugoslavia	AT-3 'Sagger'	Wire	Basic versions have 2.6 kg HEAT warhead and piezo fuze. Many variants, including: 9M14P1 (with stand-off probe and inertia fuze); 9M14-2 (with 3.5 kg HEAT warhead). 9M14-2M (tandem HEAT warhead). In use by more than 30 countries
9M11 'Skorpion'	Russia	AT-2A 'Swatter'	Radio	HEAT warhead, impact fuze
9M17 'Falanga'	Russia	AT-2B and C 'Swatter'	Radio	HEAT warhead, impact fuze
9M111, 9M111M 'Fagot'	Russia, Bulgaria	AT-4 'Spigot'	Wire	9M111M has an improved 2.5 kg warhead; Bulgarian version referred to as 'Factoria'
9M113, 9M113M 'Konkurs'	Russia, Bulgaria, India, Slovakia	AT-5 'Spandrel'	Wire	9N131 is the 2.7 kg HEAT warhead. 9K113M is an upgraded version with a tandem HEAT warhead and an extending nose probe
9M114 'Kokon'	Russia	AT-6 'Spiral'	Radio/Laser	5.4 kg HEAT warhead
9M114M1 and M2 'Shturm' 2 and 3	Russia	AT-9 'Spiral 2'	Radio command/ Laser homing	7.4 kg HEAT warhead
9M115 'Metis'	Russia, Bulgaria	AT-7 'Saxhorn'		94 mm HEAT warhead
9M117 and 117M 'Bastion' and 'Kastet'	Russia	AT-10 'Stabber'	Laser beam-rider	100 mm gun-launched missile 9M117M has a tandem HEAT warhead. System is designated 9K116. Variants are available for both rifled and smoothbore 100 mm guns
9M117M 'Sheksna'	Russia	AT-10 'Stabber'	Laser beam rider	AT-10 variant for the smoothbore 115 mm T-62 gun
9M119 and 119M 'Refleks' and 'Svir'	Russia	AT-11 'Sniper'	Laser beam rider	125 mm gun-launched missile. HEAT warhead at rear of missile, with rocket in front and side-mounted venturi. 9M119M has a tandem HEAT warhead
9M120 'Vikhr', 'Sheksna' and 'Ataka'	Russia	AT-12 'Swinger'	Laser beam rider	HE frag expanding rod, thermobaric, HEAT and tandem HEAT warheads available. Reported to have impact and proximity fuzes
9M120M/121 'Vikhr-M'	Russia	AT-16	Laser beam rider	8 kg HEAT warhead with impact and proximity fuzes
9M131 and 9M131F 'Metis-M'	Russia	AT-13	Wire	Choice of 130 mm warheads, including 4.6 kg tandem HEAT (9M131) and 4.95 kg thermobaric (9M131F)
9M133-1 and 9M133F-1 'Kornet-E'	Russia	AT-IX-14	Laser beam rider	Derivative of 9M115, with 4 fins instead of 3. Warheads are 152 mm HEAT (9M133-1) or thermobaric (9M133F-1)
Baktar Shikan	Pakistan		Wire	Copy of Red Arrow 8 with unitary or tandem HEAT warheads
Bumble Bee	Serbia			Similar to French 'Eryx'. Tandem warhead
Ingwe	South Africa		Laser beam rider	Tandem HEAT warheads; side-mounted venturi
Kuen Wu 1	Thailand		Wire	Copy of AT-3 'Sagger'. See 9M14
Nimrod	Israel		Inertial and semi-active laser	Unusually large ATGM (2.6 m long)
Maljutka	Former Yugoslavia	AT-3 'Sagger'	Wire	Copy of AT-3 'Sagger'. See 9M14
MAPATS	Israel		Laser beam rider	3.6 kg HEAT warhead
RAAD and I-RAAD	Iran	AT-3 'Sagger'	Wire	Based on AT-3 'Sagger'. See 9M14. I-RAAD is an improved version with tandem HEAT warhead
Red Arrow 73	China		Wire	Copy of AT-3 'Sagger'. See 9M14
Spike-MR, LR and ER	Israel		Fibre optic or fire-and-forget	Also known as 'Gill'. Tandem HEAT warheads
Toophan 1 and 2	Iran		Wire	Copy of the US TOW. 3.6 kg unitary or 4.1 kg tandem warheads
Type 79	Japan		Wire	Similar to US TOW; HEAT or SAP warhead

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A Russian SA-2f 'Volga' 5Ya23 missile in Iraq, with major assemblies marked (Colin King) 1121157

The V-88M fragmentation warhead for the SA-2f weighs 195 kg and contains 90 kg of HE (Colin King) 0573826

Styx, Silkworm and Seersucker warheads weigh 454 kg and incorporate a massive shaped charge (Colin King) 0573828

Tanks containing liquid oxidant for missiles (Colin King) 1341690

HY-2 'Seersucker' anti-ship missiles. The centre missile (labelled) has an empty warhead compartment (Colin King) 0573827

LIQUID-FUELLED MISSILES

Description

Although most missiles use solid propellant, some of the older high-altitude Surface-to-Air Missiles (SAM) and long-range Surface-to-Surface Missiles (SSM) have liquid-fuelled sustainer motors. The most commonly encountered examples are the Russian SA-2 'Guideline' high-altitude SAM and the Russian SS-N-2 'Styx' anti-ship SSM. Chinese versions of 'Styx' include the HY-1 'Silkworm' and the larger HY-2 'Seersucker'. These 2-stage missiles have large (around 500 kg) solid fuel booster motors and liquid-fuelled sustainers using a hypergolic (self-igniting) mixture of oxidiser and fuel. Russian rocket motors have also been used, or copied, in several indigenous ballistic missile programs. The Indian 'Prithvi' and Iraqi 'Al Samoud' missiles were based on the SA-2 motor, while the North Korean 'Hwasong' missile series were based on Scud. Liquid fuels tend to be associated with older, low-technology motors, but they have seen a resurgence with missiles such as the North Korean Nodong and Taepo'dong, the Iranian Shahab 3 and the Pakistan Hatf 5. The US NCADE missile interceptor uses hydroxylammonium nitrate (HAN), a high density monopropellant, for second stage propulsion to combine light weight with high velocity. Many of the liquid propellants, such as Inhibited Red-Fuming Nitric Acid (IRFNA), High-Test Peroxide (HTP) and Unsymmetrical DiMethylHydrazine (UDMH), are hazardous in their own right. Some oxidants will spontaneously ignite or explode in contact with fuel or other organic material, making leaking missiles particularly dangerous. Fragmentation warheads are most common, with some of the larger types exceeding 200 kg. The warhead is normally located forward of the rocket motors, but behind the nose cone (which generally contains guidance components).

Operational details

Typical operation

SA-2 has a large solid-fuel booster motor, which burns for 3 to 5 seconds and is then jettisoned as the liquid-fuelled sustainer motor takes over. Once the missile is near the target, the onboard contact and proximity fuzing system is armed, although the warhead may also be command detonated. The self-destruct fuze functions after 60 seconds of unguided flight, or after 115 seconds if the missile fails to engage the target. 'Styx', 'Silkworm' and 'Seersucker' have a solid-fuel booster mounted beneath the fuselage, and are launched with both booster and sustainer motors burning. All of these systems use IRFNA as an oxidant and a Kerosene/amine-based fuel known as 'Tonka' (Russian designation TG-02). SA-2 carries 350 litres of IRFNA and 210 litres of TG-02 fuel. These liquids are maintained under high pressure from on-board air tanks, which also constitute a hazard to EOD technicians. Despite containing a corrosion inhibitor, IRFNA tends to corrode internal components and, eventually, liquid-fuelled missiles begin to leak. Because the propellants are hypergolic, leaks can result in the missile catching fire, exploding or launching spontaneously. All of these missiles contain very large warheads (see specifications), capable of causing damage and injury at substantial distances. The SA-2 warhead has a pre-fragmented casing while the anti-ship missile warheads incorporate a massive shaped charge.

EOD considerations

- Fuel de-tanking, and removal of the booster and warhead are the preferred means of disposal
- Specialist equipment and detailed knowledge are needed for de-tanking and disassembly
- The location of the warhead and fuel tanks must be verified before demolition
- Liquid fuels and oxidants may be under high pressure
- Missiles are likely to develop leaks if left fuelled for extended periods
- Liquid fuels and oxidants may be capable of spontaneous ignition or explosion if they mix
- Large warheads have a substantial danger radius, particularly from shaped charges
- Large booster motors require careful handling and demolition procedures
- Booster solid propellant may be capable of detonation under some circumstances
- Many liquid propellants are toxic and have a downwind hazard area
- High-pressure gas, electrical systems and pyrotechnic charges may create additional hazards.

Typical specifications

Example	Chinese HY-1 'Silkworm'	Chinese HY-2 'Seersucker'	Russian SA-2f 'Guideline'	Russian SS-N-2b 'Styx'
Type:	Anti-ship SSM	Anti-ship SSM	High altitude SAM	Anti-ship SSM
Length:	5.8 m	7.36 m	11.2 m	5.8 m
Body diameter:	760 mm	760 mm	650 mm (booster), 500 mm (missile)	760 mm
Weight:	2,300 kg	2,500 kg	2,395 kg	2,300 kg
Warhead weight:	454 kg	454 kg	195 kg (90 kg HE)	454 kg
Warhead type:	Shaped charge	Shaped charge	Fragmentation	Shaped charge
Fuzing:	Proximity, contact	Proximity, contact	Proximity, contact or command	Proximity, contact

Notes

IRFNA is a mixture of several acids and additives; it has a maximum shelf life of five years and should be stored below 20°C. See also the entry on *Liquid propellants* in the *Background Information* section.

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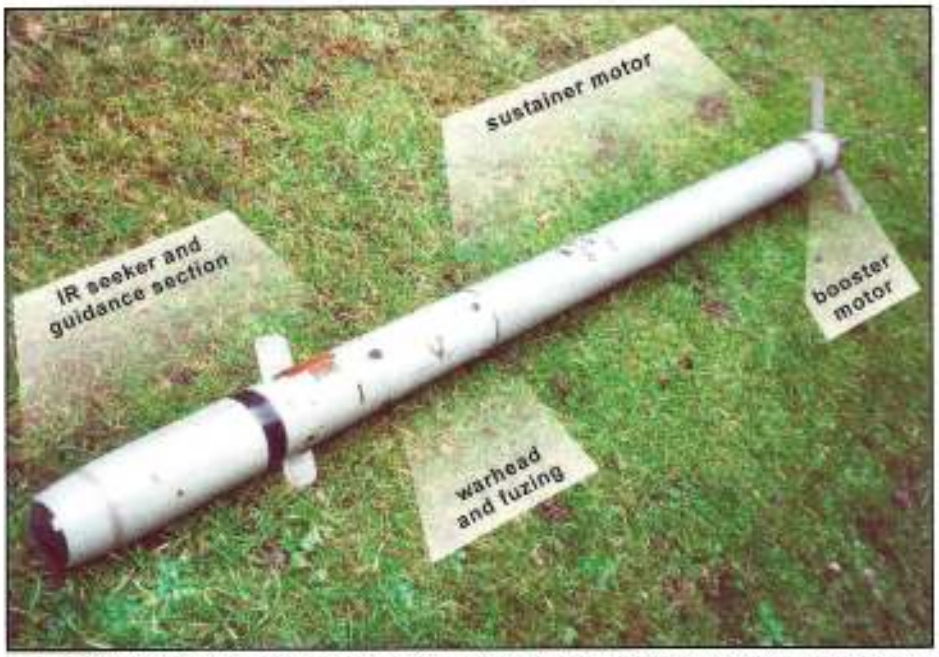
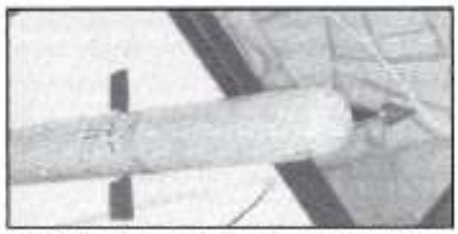
SA-7 in its launch tube. The nose of the missile is in the foreground, with the lens of the seeker head just visible (Colin King) 0573792



Major component sections of the Russian SA-7 shoulder-launched SAM. The US Stinger has the same layout (Colin King) 1121156

Launchers for the Russian SA-7 (above) and the US Stinger (below) (Colin King) 1041031

Seeker heads from the Chinese QW-1 Vanguard (left) and FN-6 (right) (Colin King) 1121171



The distinctive nose assembly of the Russian SA-16; SA-18 has a single spike (Christopher F Foss) 0022852

The booster motor of the Chinese QW-1 Vanguard (Colin King) 1121172

The thermal battery from a Yugoslav copy of the SA-7; these have occasionally been wrongly identified as landmines (Colin King) 0074266

MAN-PORTABLE SURFACE-TO-AIR MISSILES

Description

'Man-Portable Air Defence Systems' (MANPADS) use broadly similar shoulder-launched Surface-to-Air Missiles (SAM) developed from the design of the obsolete US 'Redeye' missile. The most common example, the Russian SA-7 'Grail', is currently believed to be in service with about 75 countries, some using licence-built or local copies. The newest Russian designs (such as SA-18 'Grouse') are closely based on the US 'Stinger', which is currently in service with more than 30 countries. The missiles are made up from a series of cylindrical assemblies attached, one behind the other, to create a parallel-sided casing. All have solid-propellant booster and sustainer motors with venturis at the rear. The fragmentation warhead and fuzing system are mounted behind the power and guidance unit and forward of the motors. The nose of the missile houses the Infra-Red (IR) seeker head and guidance electronics. In the field, the missiles are usually contained in their disposable fibreglass launch tubes, which can make identification and demolition difficult. The launchers use removable thermal batteries, which burn a gasless pyrotechnic composition to melt the electrolyte. Although these are relatively harmless, some are combined with gas bottles (used for cooling the IR seeker heads), which can be pressurised up to 6,000 psi. Normal batteries are parallel-sided, whereas those incorporating gas bottles are normally recognisable by a bulbous portion covered with black rubber. For firing, the launch tube is fitted onto a 'grip-stock' assembly, which allows the user to aim, acquire the target and launch the missile; the grip-stock contains no hazardous components.

Operational details

Typical operation

The operation of the SA-7 is typical of shoulder-launched SAMs. As a target approaches, the user twists a key on the thermal battery (located towards the front of the launch tube). This actuates the battery, providing power to the system for approximately 1 minute. Once the battery has expired it must be discarded and replaced. When fired, the booster motor is ignited to kick the missile out of the launch tube, impart spin and light the pyrotechnic delay for the sustainer motor. The booster occupies the rear section of the casing and vents through four small venturis around the edge of the base. Approximately 0.3 seconds after the missile leaves the launch tube the main motor is ignited, using a single centrally mounted venturi in the base of the missile. This motor accelerates the missile to supersonic speed in around 1 second. During flight, a gas generator in the guidance section provides power directly to the steering fins, and drives a turbine to generate power for the electrical components. The warhead has three integral fuzing components mounted in the base; a G-switch functions in case of direct impact, while a crush switch is designed to operate if the missile strikes a glancing blow. The third fuzing component is a self-destruct pyrotechnic delay, which is ignited during launch and functions after 14 to 17 seconds if there has been no impact. The self-destruct delay on the US 'Stinger' functions after 20 seconds; this missile also ejects its booster motor after launch.

EOD considerations

- In order to avoid the IR seeker, unexploded missiles should not be approached from the front
- Partially impacted G-switches and crush fuzes may be in a highly sensitive condition
- The location of the warhead and rocket motors should be verified before demolition
- Demolition procedures must destroy the venturi to prevent unfired missiles from being launched
- Unburned propellant may be capable of detonation under some circumstances
- Thermal battery assemblies may contain gas under high pressure.

Typical specifications

Example	Russian SA-7 'Grail'	Russian SA-14 'Gremlin'	US FIM-92 'Stinger'
Guidance:	IR homing	IR homing	IR/UV homing
Body diameter:	72 mm	72 mm	70 mm
Length:	1.44 m	1.47 m	1.52 m
Weight:	9.6 kg	10.3 kg	10.1 kg
Warhead weight:	1.17 kg	1.15 kg	1 kg
Warhead type:	HE frag	HE frag	HE frag
Fuzing:	Impact and self-destruct delay	Impact and self-destruct delay	Impact and self-destruct delay

Notes

Shoulder-launched SAMs are often mounted on helicopters for use in an air-to-air role. For details of countries using these systems, see the munition inventories and national production tables in the *Data summary* section. See also the *Missile identification charts* in this section.

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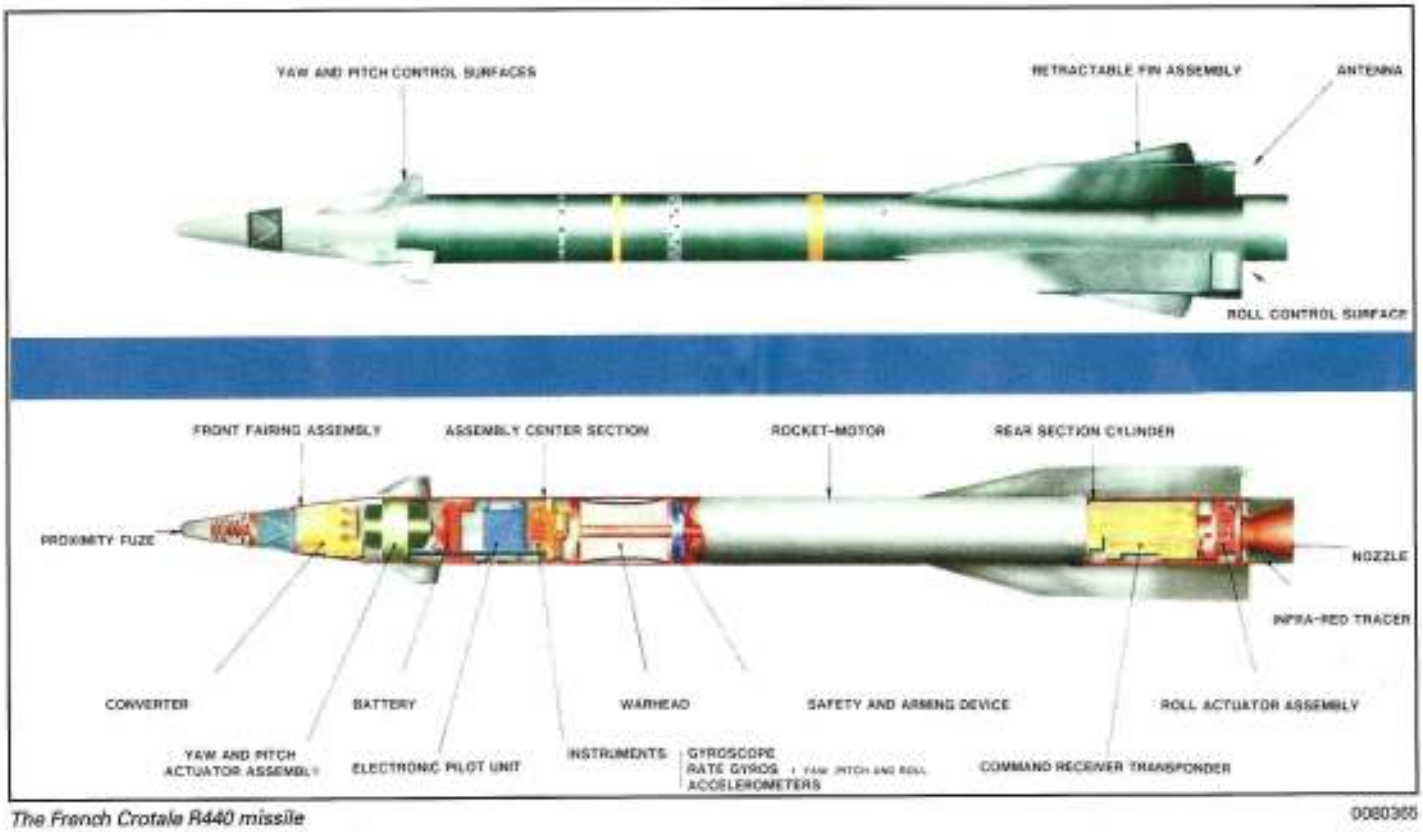
Discarded Roland missiles in their launch tubes, which make identification and disposal more difficult (Colin King) 0673793

Detonation of a Roland 3 warhead shows the effect of the multiple shaped charges 0067656

A typical fragmentation warhead from a large SAM (Colin King) 0074711



The French Crotale R440 missile 0080365

SURFACE-TO-AIR MISSILES – STATIC AND MOBILE

Description

Static and mobile Surface-to-Air Missiles (SAM) vary substantially in size and design, depending on their role. Modern low-altitude missiles are generally quite compact, while missiles with a high-altitude capability tend to be far larger (owing mainly to the need for bigger motors). For example, the Russian SA-9 is basically a larger version of the SA-7, at 1.8 m long and weighing 30 kg, while the SA-4 'Ganef' missile is nearly 9 m long and weighs almost 2,500 kg. Although most SAMs use solid propellant, some of the older high-altitude missiles have liquid-fuelled or ramjet sustainer motors. Liquid propellants can be extremely hazardous and significantly complicate an EOD operation; this issue is dealt with separately under *Liquid-fuelled missiles*. Ramjets, such as the sustainer motor in the SA-4, generally use Kerosene fuel, although the Russian SA-6 ramjet is fed by a solid-fuel gas generator. Modern SAMs may use composite propellants, in which oxidant and fuel, or HE particles, are bound into a polymer, such as HTPB (Hydroxy-Terminated Polybutadiene Binder).

Fragmentation warheads are most common, with some of the larger types exceeding 200 kg. The warhead is normally located forward of the rocket motors, but behind the nose (which often contains the guidance system). Fuzing options include command (from the ground station), proximity and contact, with most missiles having some combination of these and also incorporating a self-destruct device. Various proximity fuzes are used, including active and passive IR, Doppler radar and active laser; these fuzes may be in the nose and forward-looking, or mounted in the casing looking sideways. Missiles are often encountered in storage or launch tubes, which can make identification and disposal more difficult. Large warheads and boosters may be stored separately from the missile, and can also be difficult to identify.

Operational details

Typical operation

Many of the solid-fuelled missiles operate in a similar manner to the shoulder-launched SAMs, although they tend to be controlled by ground-based radar systems. At launch, the booster motor (if present) burns violently for between one and three seconds to accelerate the missile to supersonic speed. After this, the sustainer motor takes over, typically giving 10–20 seconds of powered flight. Once the missile is a safe distance from the launcher, the fuzing system is armed, and a self-destruct delay begins; the missile should self-destruct as, or shortly after, the sustainer motor expires. Most SAMs are fitted with proximity fuzes, but many also incorporate a contact fuze. Warheads generally incorporate fragmentation, with some using the 'expanding rod' system, in which a cylindrical concertina of steel rods is projected into a large circle of fragments during detonation. Newer warheads may incorporate directional fragmentation or multiple shaped charges. The 'effective' warhead fragmentation radius (against aircraft) varies from approximately 8 m for smaller missiles to well over 100 m for the larger types, although fragmentation would be lethal to people at far greater ranges. Gas generators, gas bottles, thermal batteries and pyrotechnic squibs are used in many SAMs, and may constitute secondary hazards to EOD technicians.

EOD considerations

- Sensors and proximity fuzes should be identified and avoided when approaching missiles
- Strict radio frequency precautions are needed during approaches
- Contact fuzes may be located externally, on the leading edge of fins, for example
- The location of the warhead and rocket motors should be verified before demolition
- Some warheads use shaped charges and directional fragmentation
- All explosive components must be attacked simultaneously during demolition
- Demolition procedures must ensure that venturis are crushed to prevent rocket motors from launching
- Unburned propellant may be capable of detonation under some circumstances
- High-pressure gas, electrical systems and pyrotechnic charges may create additional hazards.

Typical specifications

Example	French Crotale R440	International Roland 2	Russian SA-3a
Type	Low altitude	Low to medium altitude	Low altitude
Body diameter:	0.15 m	160 mm	390 mm
Length:	2.89 m	2.4 m	5.88 m
Weight:	84 kg	66.5 kg	933 kg
Warhead weight:	15 kg	6.5 kg (3.3 kg HE)	60 kg
Warhead type:	Fragmentation	Fragmentation and shaped charge	Fragmentation
Fuzing:	Proximity and contact	Proximity and contact	Radar proximity and contact

Notes

Shoulder-launched and liquid-fuelled SAMs are covered in separate entries; see also the *Missile identification charts* and *Russian surface-to-air missile designations* in this section.

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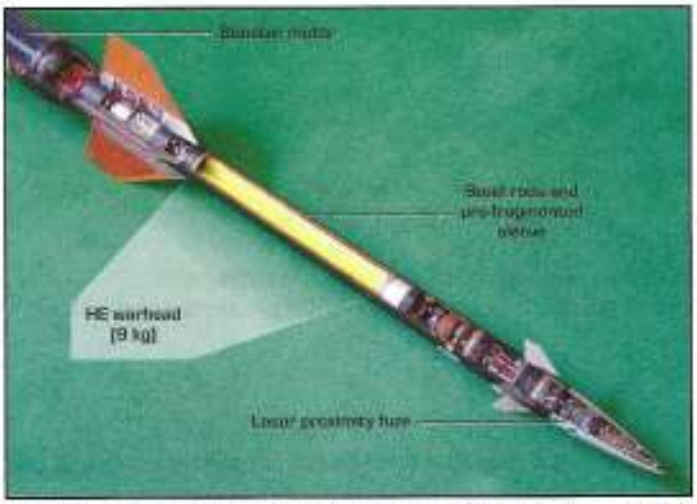
The Russian SA-3 'Goa' is in use with more than 30 countries (Colin King) 1121155

The Russian SA-4 'Ganef' has a 150 kg warhead with contact and proximity fuzes (Colin King) 1041032



The forward section of a sectioned Russian SA-19 (Colin King) 1341743

The Russian SA-9 is normally seen in its characteristic launching crate (Colin King) 1375740

RUSSIAN SURFACE-TO-AIR MISSILE DESIGNATIONS

NATO designation	NATO nickname	Russian name	Russian designation
SA-1	Guild, Gaffer	Berkut	S-25
			R113
SA-2b	Guideline Mod 1	Desna	S-75
SA-2c	Guideline Mod 2	Volkhov	S-75M
SA-2d	Guideline Mod 3	Volkhov	S-75M
SA-2e	Guideline Mod 4	Volkhov	S-75M
SA-2f	Guideline Mod 5	Volkhov	S-75M
SA-2 upgrade	Guideline	Volga-M	S-75M
		Volga-2	
SA-3a	Goa Mod 0	Neva	S-125
SA-3b	Goa Mod 1	Neva-M ('Pechora')	S-125M
SA-3 upgrade	Goa	Pechora-M	S-125
		Pechora-2	
SA-4a	Ganef Mod 0	Krug	2K11
SA-4b	Ganef Mod 1	Krug-M	2K11
	Griffon		RZ-25
SA-5	Gammon	Angara	S-200
SA-5a		'Russian River'	S-200V, VE
SA-5b		Vega	S-200D, DE
SA-5c		Vega-E	S-200C
SA-5d			
SA-5e			
SA-6a	Gainful Mod 0	Kub ('Kvadrat')	2K12
SA-6b	Gainful Mod 1	Kub-M	2K12
SA-7a	Grail	Strela-2	9K32
SA-7b		Strela-2M	9K32M
SA-8a	Gecko Mod 0	Osa ('Rom6')	9K33
SA-8b	Gecko Mod 1	Osa-AK	9K33M3
		Osa-AKM	
SA-9a	Gaskin	Strela-1	9K31
SA-9b		Strela-1M	
SA-10A	Grumble		S-300P
			S-300PT/PT-1A
SA-10b	Grumble		S-300PMU S-300PMU-1
SA-10c	Grumble		S-300PS/PM
SA-11	Gadfly	Buk ('Gang')	9K37
SA12a	Gladiator		S-300V
			V1
			VM1
SA12b	Giant		S-300V
			V2
			VM2
SA-13	Gopher	Strela-10	9K35
		Strela-10M	
		Strela-10M2	
		Strela-10M3	
		Strela-10M4	
		Strela-10SV	
SA-14	Gremlin	Strela-3	9K34
		Strela-3M	
SA-15	Gauntlet	Tor	
		Tor-M1	
SA-16	Gimlet	Igla	9K38
		Igla-1	9K310
		Igla-1E	
SA-17	Grizzly	Buk-M1	9K40
		M2	
SA-18	Grouse	Igla-M	
		Igla-1M	
SA-19	Grisson	Tunguska	2K22
		Tunguska-M	2K22M

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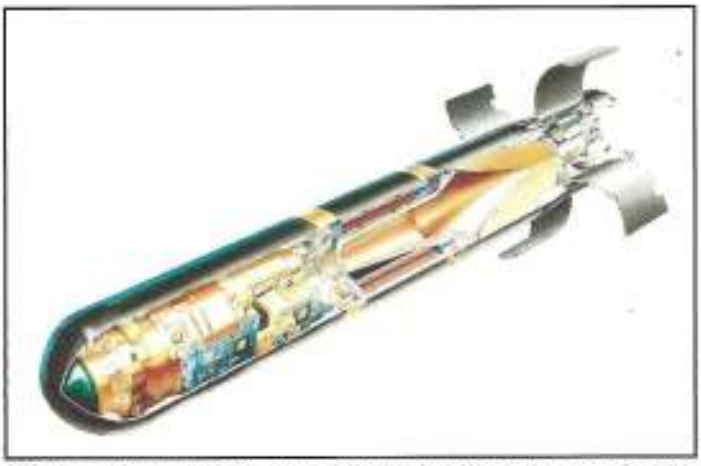
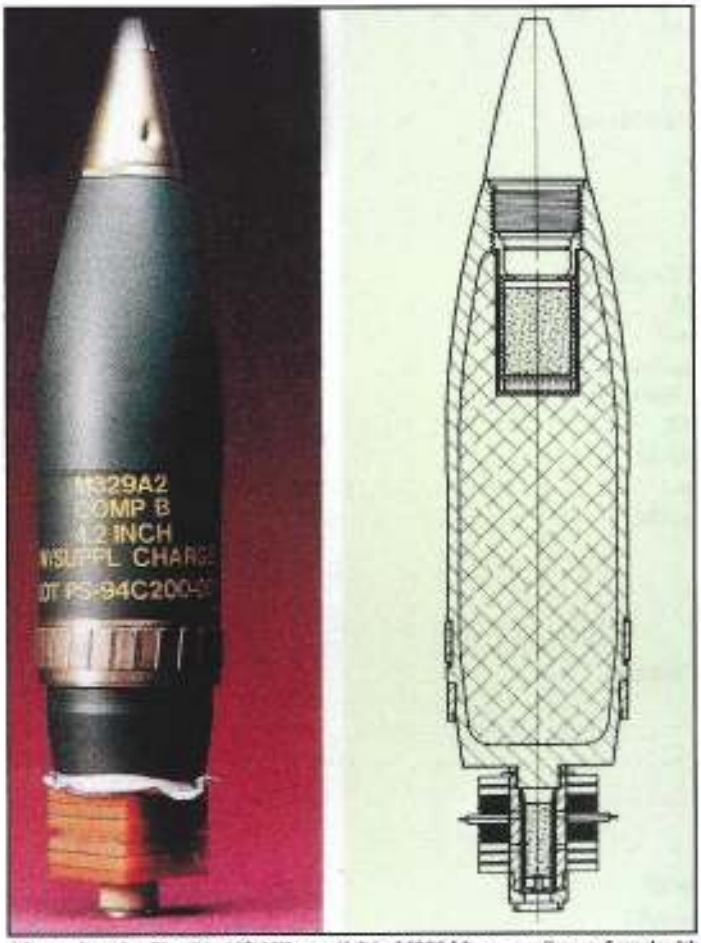


Cutaway diagram of the Strix 120 mm guided mortar bomb. Note the HEAT warhead at the rear (Bofors Defence/Saab Bofors) 0095129

Yugoslav 82 mm HE mortar bombs in Kosovo (Colin King) 1310460



Mortar bombs like this US 107 mm/4.2 in M329A2 are easily confused with projectiles. Note the rifling and absence of tailfins 0054715

Spanish 120 mm mortar bombs. From the top: HE, WP with HE burster, smoke (Colin King) 1041033

British 2 in mortars have been copied by India and Israel. From the top: HE, smoke and illuminating (Colin King) 0573794

British 81 mm mortar bombs. From the left: illuminating, smoke (White Phosphorus), HE, with augmentation charges to the right (Colin King) 0074712

British 51 mm smoke and illuminating rounds (Colin King) 1341744

MORTAR BOMBS

GENERAL

Description

The main identification feature for a mortar bomb is the spigot or tail section, which invariably has holes to vent the primary propellant charge and normally (but not always) has fins. There are numerous types and many are similar in shape, making it difficult to recognise or identify each one positively. Most bomb bodies have smooth obturating rings, although some have an expanding copper driving band which is engraved by rifling during firing. Consequently, although the standard shapes are clearly recognisable as mortar bombs, some are externally similar to projectiles and are easily confused; the US 4.2 in M329A2, for example, has a rifled driving band and no fins (see photograph).

Mortar bombs can be broadly divided into two categories: HE and carriers. With older ammunition, it is often possible to identify the type from the external shape and the type of fuze, however, the trend towards low-drag, ballistically matched ammunition means that different varieties may share the same profile, with the exact type denoted only by the markings. Older mortar bombs tended to use a single charge within the tail spigot, with range adjusted purely by the elevation of the firing tube. In addition to the primary charge, most modern ammunition is supplied with secondary 'augmentation charges', which are clipped around the tail spigot or between the fins. Although rare, some mortar bombs, such as the French 120 mm PEPA, incorporate rocket motors in addition to the standard propellant charges. Some guided mortar bombs are now in service; these are significantly different in appearance and construction to conventional ammunition and, for EOD purposes, should be treated as missiles.

Operational details

Typical operation

Mortar bombs are normally fitted with nose fuzes, which often have a safety pin or clip passing through the fuze body. The pin locks internal components in place to prevent arming or initiation during transit or rough handling, and is removed before firing. As the mortar bomb is fired, the primary cartridge in the tail spigot is initiated by a percussion cap. The thin plastic or paper seal around the propellant is ruptured to allow the expanding gases to vent through ignition holes in the tail. The rupturing of the primary cartridge casing is one means of establishing whether a mortar bomb has been fired. In most modern mortar ammunition, the primary cartridge ignites secondary 'augmentation charges', greatly extending range. In some rifled mortars, the pressure generated in the tube forces a bevelled steel plate up inside a copper cup at the base of the body; as the copper cup is expanded, it engages with the rifling in the same way as a driving band on a projectile. This mechanism is necessary to allow the bomb to be fed down the muzzle without jamming. During firing, the fuze is normally armed by setback, although fuzes for use in rifled mortars may also use spin in the arming process. Most HE mortar bomb fuzes are relatively simple in design, functioning on impact or after a very short delay. Carriers are normally opened by delay fuzes, although some newer types are fitted with proximity fuzes.

EOD considerations

- Demolition procedures must prevent unfired mortar bombs from being launched by their cartridges
- Fuzes are often badly damaged during impact and may be impossible to identify
- Identification by shape alone can be misleading; in some cases, it is not possible at all
- Some types of mortar ammunition look very similar to projectiles and are easily misidentified
- Increment charges must be protected from sources of accidental ignition.

Typical specifications

Example	UK L42	US M329A2	Spanish Model N
Type:	Smoke, WP	HE/frag	HE/frag
Calibre:	81 mm	107 mm (4.2 in)	120 mm
Weight:	4.4 kg	9.98 kg	16.6 kg
Length:	482 mm	650 mm	668 mm
Filling:	900 g White Phosphorus	2.6 kg Comp B	3.1 kg TNT
Fuzing:	Impact	Impact/proximity	Impact

Notes

The most common mortar calibres are: 50 mm, 51 mm, 52 mm/2 in, 60 mm/3 in, 81 mm, 82 mm, 100 mm, 107 mm/4.2 in, 120 mm, 160 mm and 240 mm. See also separate entries for *High explosive mortar bombs* and *Carrier mortar bombs.*

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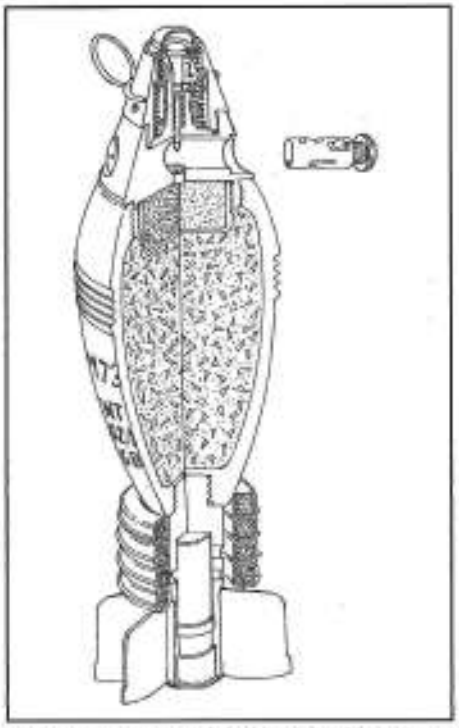
Russian 240 mm F-864 HE mortar bombs (Colin King) 0074231



Sectioned diagram of the Yugoslav M73 60 mm HE mortar bomb (Lyn Haywood) 0074139

This Chinese 82 mm HE mortar bomb is almost identical to the Russian O-832. Note the safety pin fitted to the fuze (Colin King) 0074713

The Yugoslav M73 60 mm HE mortar (Colin King) 1121154

Rifled mortar bombs, such as the French 120 mm PR 14, are easily confused with projectiles (Ollie Allerhead) 1121153

French 60 mm mortars, with a Yugoslav example on the right; note the increment charge capsules between the fins (Colin King) 0673795

HIGH EXPLOSIVE MORTAR BOMBS

Description

The vast majority of HE mortar bombs are simple munitions designed for blast and fragmentation. Blast/fragmentation projectiles tend to have thick steel bodies with a bulk fill, often TNT or Composition B. Impact (point detonating) nose fuzes are most common, though other types (including proximity, base fuzing and short delay) may be used for special purposes. Some types of mortar ammunition, such as the British 2 in (and copies), incorporate unique external characteristics to clearly indicate their function, but this is exceptional. In most modern mortar bomb series, body shapes are similar and only the markings will indicate the fill. Most bomb bodies have smooth obturating rings, although some others have an expanding copper driving band which is engraved by rifling during firing. Although the standard shapes are clearly recognisable, some (such as the US 4.2 in M329A2, which has a rifled driving band and no fins) are externally similar to projectiles and are easily confused. In the standard teardrop-shaped former Warsaw Pact pattern bombs, joints in the casing may indicate something other than a simple HE fill, such as White Phosphorus (WP) or a HEAT warhead. Some modern systems, such as the Swedish 'Strix', the Russian 'Gran' and the US/German Precision-Guided Mortar Munition (PGMM) use guided bombs with High Explosive Anti-Tank (HEAT) warheads. These are significantly different from conventional mortar bombs in appearance and construction; for EOD purposes, these should be treated as missiles. Some designs, such as the French 120 mm PEPA, incorporate rocket motors in addition to the normal propellant cartridges.

Operational details

Typical operation

Before firing, a safety pin is normally removed from the nose fuze; failure to remove this device is one of the prime causes of mortar bombs failing to function. At the base of the mortar tube, a firing pin initiates a central percussion cap, igniting the charge inside the tail assembly of the bomb. The propellant gas is vented through holes in the side of the tail spigot, igniting the external increment charges (if fitted). In some rifled mortars, the pressure generated in the tube forces a bevelled steel plate up inside a copper cup at the base of the body; as the copper cup is expanded, it engages with the rifling in the same way as a driving band on a projectile. This mechanism is necessary to allow the bomb to be fed down the muzzle without jamming. As the bomb is launched up the tube, the fuze is generally armed by setback, though spin may also be used as an arming action in those fired from rifled tubes. Most fuzes for HE bombs function on impact or after a very short delay. Delay fuzes may be mechanical, electronic or pyrotechnic, with delays ranging from microseconds to minutes. Proximity fuzes are electronic and are often set using a hand-held programmer. On detonation, the casing of a blast/fragmentation projectile is shattered to maximise its lethal range.

EOD considerations

- Demolition procedures must prevent mortar bombs from being launched by their cartridges
- Fuzes are often badly damaged during impact and may be impossible to identify
- Positive identification by shape alone is not always possible
- WP munitions generally contain a substantial HE burster
- Some types look very similar to projectiles and are easily misidentified
- Increment charges must be protected from sources of accidental ignition.

Typical specifications

Calibre	60 mm	82 mm	120 mm	240 mm
Example	Yugoslav M73	Russian O-832	French PR 14	Russian F-864
Length:	286 mm	329 mm	897 mm	1.56 m
Weight:	1.35 kg	3.23 kg	18.6 kg	131 kg
Explosive weight:	220 g	436 g	3.5 kg (est)	32 kg
Explosive type:	TNT	TNT/Dinitronapthalene	TNT	TNT
Fuzing:	Impact	Impact	Impact/short delay or proximity	Impact

Notes

Some mortar bomb designs are widely copied, making positive identification of their origin difficult. The Russian 82 mm O-832 series, for example, has been copied by China and throughout the former Warsaw Pact, while British pattern 2 in (52 mm) mortar ammunition is manufactured in India and Israel. For additional images, see *Mortar bombs – general.*

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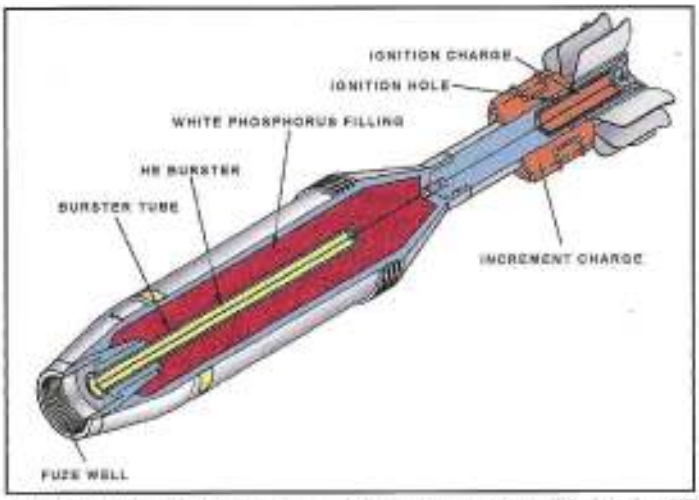
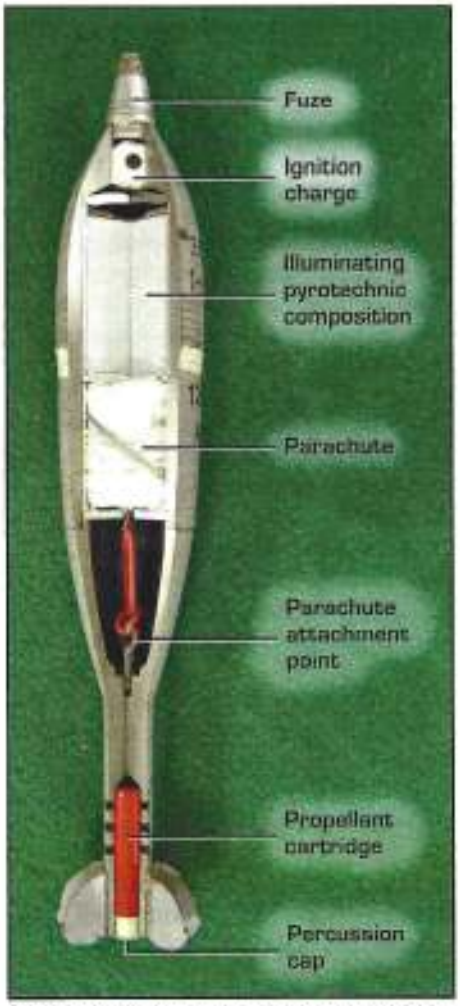


US 81 mm M57 smoke round containing White Phosphorus (WP) and an HE burster 0532014

An Israeli mortar bomb containing submunitions (Colin King) 1341644

A rifled Turkish Mod 258 submunition carrier (right) (Colin King) 0573798

A submunition carrier, with electronic delay fuze (Colin King) 0573796



Components of a Russian 120 mm illuminating round (Colin King) 1341646

White phosphorus rounds. From the top: 81 mm US M57, 81 mm British L40A1 and a Belgian copy of the 60 mm US M302 (Colin King) 1041034

The contents of a Chinese 82 mm Type 53 leaflet bomb found in Cambodia (Colin King) 0074232

CARRIER MORTAR BOMBS

Description

Mortar bombs designed to dispense a payload are known as 'carriers'. Payloads may include smoke mixtures, red or White Phosphorus (WP), flares or illuminants, incendiaries, lachrymatory or other chemical agents, leaflets, radio echo 'chaff', submunitions or radio jamming transmitters. The payload can be nose-ejected (NE), base-ejected (BE) or dispersed by a bursting charge. Bursters are usually used with phosphorus and chemical fills; they normally consist of a small HE charge housed in the base of the fuze, or in a tube running through the centre of the bomb body. Carriers using bursting charges may have the same profile as HE bombs, making identification reliant on markings and fuzing. Mortar bombs which eject their payload (such as submunitions, parachute flares and smoke canisters) are often parallel sided, although this is not always the case. The ejection charge is a propellant (such as Black Powder) rather than HE, and is normally located immediately behind the fuze. Ejecting mortar bombs are visibly empty if they have functioned correctly. Carriers are normally nose-fuzed, using a delay (mechanical, pyrotechnic or electronic) or proximity fuze, although impact fuzes are also used in some cases.

Operational details

Typical operation

Carriers are prepared in the same way as HE mortars (see separate entry), except that time fuze delays are set before firing. A percussion cap ignites the propellant charge inside the tail assembly of the bomb and the gas is vented through holes in the side of the tail spigot, igniting the external increment charges (if fitted). Fuzes are generally armed or initiated by setback during firing, though spin may also be used as an arming action in those fired from rifled tubes. Bursting carrier bombs generally function on impact, the central HE charge detonating to shatter the casing and disperse the filling. Phosphorus ignites spontaneously as it passes through the air, producing a combination of smoke and incendiary effects. Ejecting carriers normally use delay or proximity fuzes to initiate a small propellant charge. Once the delay has expired or the proximity fuze has functioned, the ejection charge is ignited to jettison the nose or base, eject the payload and (in the case of pyrotechnics) ignite the payload. Delay fuzes may be mechanical, electronic or pyrotechnic, with delays usually between 3 and 90 seconds. Proximity fuzes are electronic and are often set using a hand-held programmer.

EOD considerations

- Demolition procedures must prevent projectiles from being launched by their cartridges
- If the fill cannot be identified, the 'worst case' must be anticipated (see *Notes*)
- Fuzes are often badly damaged during impact and may be impossible to identify
- Proximity fuzes should not be approached from the front
- Particular care must be taken to avoid 'kick-outs' during the demolition of submunition carriers
- Identification by shape alone can be misleading
- Increment charges must be protected from sources of accidental ignition
- Phosphorus-filled munitions need special precautions and are likely to start fires in areas of dry vegetation
- High temperatures can cause the exudation and spontaneous combustion of phosphorus-filled munitions.

Typical specifications

Type	Submunition carrier	Illuminating	Smoke
Example:	Turkey Mod 258	US M301	US M57 smoke
Calibre:	120 mm	81 mm	81 mm
Payload:	16 submunitions (M85)	3 parachute flares	White phosphorus
Length:	827 mm	571 mm	523 mm
Weight:	23 kg	4.85 kg	5.6 kg
Payload weight:	3.2 kg	600 g (est)	1.8 kg (WP)

Notes

A payload of mines or submunitions can give a carrier mortar bomb an explosive content equivalent to an HE mortar bomb. Charges must be placed to ensure the complete destruction of the payload, particularly where 'kick-outs' might result in armed submunitions or mines.

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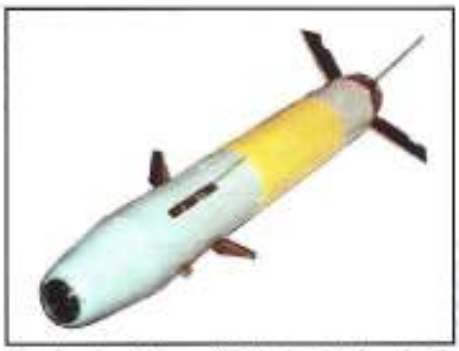
The fins on this Yugoslav 125 mm M86P1 HE projectile could lead to misidentification as a rocket (Colin King) 0632016

Unfired Russian 125 mm tank ammunition. Above: APFSDS, complete with propellant in a Combustible Cartridge Case (CCC). Below: HEAT-FS (Colin King) 0074228



The Russian 122 mm 'Kitolov' guided projectile (Colin King) 1121151

A typical base bleed unit (Colin King) 0573798

Large wartime HE projectiles; the one on the right is 18 in (457 mm) calibre and weighs over 1,000 kg (Colin King, courtesy of DEODS) 0074716

The identification of modern projectiles relies on markings; shapes tend to be standard (Colin King) 0573801

A sectioned rocket-assist unit (Colin King) 0573800

35 mm cannon ammunition (Colin King) 1310493

PROJECTILES

GENERAL

Description

Projectiles, or shells, come in an enormous range of sizes and functions; broad categories of modern projectile include cannon (20-57 mm calibre), tank and anti-tank (57-125 mm), naval and coastal defence (76 mm-5 in, although older types were up to 18 in), and field artillery (76 mm-203 mm). Many designs are copied or manufactured under licence, making it virtually impossible to recognise or identify every one. The main identification feature for a projectile is the driving band (normally made from copper), which is marked, or 'engraved', by the rifling as the shell is fired. Exceptions include projectiles with plastic obturators and those fired from smoothbore guns (which do not leave rifling marks). A few, such as US 57 mm recoilless rifle ammunition, have pre-engraved driving bands with an appearance similar to a projectile that has been fired through a rifled barrel. Projectile identification is further complicated by the similarity of some mortar bombs, particularly those fired from rifled tubes. Projectiles can be broadly divided into three categories: High Explosive (HE), carriers and kinetic (sometimes referred to as penetrators or shot). Most HE projectiles fall into one of the following categories; Armour-Piercing (AP), High Explosive Anti-Tank (HEAT), fragmentation or High Explosive Squash Head (HESH), also known as HE Plastic (HEP) in the US. These projectile categories are covered in separate entries.

With older ammunition, it is often possible to identify the type from the external shape and the presence, type and location of a fuze. However, trends in modern projectile design mean that different varieties of shell may share the same low-drag, ballistically matched profile, with the exact type denoted only by the markings. Projectiles may be fitted with nose or tail fuzes, although nose fuzes are far more common. In addition to a fuze, the base of a projectile may incorporate a tracer element, while extended range ammunition may be fitted with a 'base-bleed' unit or a rocket-assist motor. These units generally screw onto the base of the projectile, but may appear to be an integral part of the casing. Most small calibre projectiles are supplied 'fixed' into a cartridge case containing propellant. For larger calibres (normally above 125 mm), where the round becomes too heavy and long to handle, the propellant is separate, supplied in a metal cartridge case, Combustible Cartridge Case (CCC) or bag. Several types of precision guided projectile are now in service; these have many of the characteristics of missiles, but look much like conventional ammunition prior to firing.

Operational details

Typical operation

During the firing of most projectiles, the driving band is heavily engraved by the rifling, spinning the shell as it is rapidly accelerated up the gun barrel. These forces (setback and spin) are often used to arm the fuze. Tracer elements, base-bleed and rocket-assist motors are normally initiated directly from the burning propellant during firing. Base-bleed units generate enough gas to fill the vortex behind the projectile in order to reduce drag; although not as powerful as rocket motors, they still constitute a significant hazard. HE projectiles normally function on impact or after a short delay, but some are fitted with time or proximity fuzes for air-burst. Older carriers are normally opened by mechanical or pyrotechnic delay fuzes, while many modern types are now fitted with electronic delay or proximity fuzes. Kinetic projectiles are unfuzed, causing damage solely using their mass and velocity; however, most have tracer elements which are easily confused with base fuzes in old, corroded solid shot. High velocities mean that unexploded projectiles are often badly damaged on impact.

EOD considerations

- Demolition procedures must prevent projectiles from being launched by their cartridges (or rocket motors, if present)
- Fuzes are often badly damaged during impact and may be impossible to identify
- Unburned base-bleed and rocket-assist motors are an additional hazard
- Role identification by shape alone can be misleading or, in some cases, not possible at all
- Unfired guided projectiles may look like conventional ammunition, but have missile characteristics
- Modern cartridge cases for tank ammunition may use electrically initiated primers
- Some other munitions are very similar in appearance to projectiles (see *Notes*).

Typical specifications

(Projectiles, without their cartridge cases or propelling charges)

Example	Russian 53-OF-412	Russian 3BM9	US M864
Type:	HE/fragmentation	Kinetic, APFSDS	Carrier, base-bleed
Calibre:	100 mm	125 mm	155 mm
Length:	489 mm	517 mm	899 mm (unfuzed)
Weight:	15.6 kg	3.6 kg	46.3 kg (unfuzed)
Filling:	1.46 kg	Solid steel	72 submunitions (M42/M46)
Propellant:	Fixed cartridge	Integral CCC	Separate bag charges

Notes

Some types of mortar ammunition and rocket look very similar to projectiles and are easily misidentified. National colour codes for small arms ammunition and cannon projectiles are included in the Identification section. Fuzes are covered in detail in a separate section.

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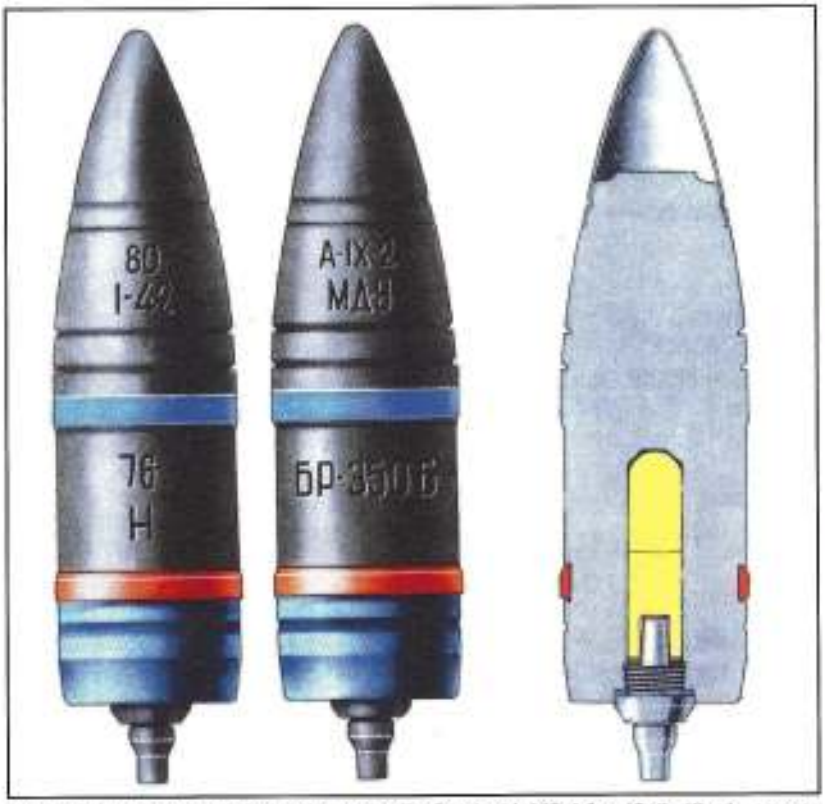
The Yugoslav M65 is a copy of the Russian BR-412 armour-piercing tracer round (Colin King) 0074718

A Russian 57 mm BR-271 APHE with driving band removed (Colin King) 0573803



The Russian 76 mm BR-350B APHE projectile, fitted with MD-8 fuze (Colin King) 1041035

The Yugoslav M60 API 20 mm cannon round (Colin King) 1310491

HIGH EXPLOSIVE PROJECTILES – APHE

Description

Armour-Piercing High Explosive (APHE) projectiles are intended primarily for use in tank and anti-tank guns, although they may also be used in anti-aircraft and coastal defence guns. APHE projectiles have largely been superseded by (non-explosive) kinetic energy rounds, which are covered in a separate entry. The projectiles have thick-walled bodies made from hardened steel; some have a sharp point while others have a blunt nose covered by a thin ballistic cap. The small HE charge is contained in a cavity at the rear of the projectile and is initiated using a base fuze; this incorporates a short delay to allow the projectile to penetrate the armour before detonating inside. The explosive may be enhanced with an incendiary composition or other additive to add to the destructive effect; such ammunition is termed 'AP-I' (Armour-Piercing – Incendiary) or 'APSE' (Armour-Piercing, Secondary Effect). APHE projectiles are used in 'fixed' rounds (fitted into a cartridge case rather than being loaded separately) and, being of older design, have copper driving bands for use in rifled barrels. The fuze housing often has an extension incorporating a tracer element.

Operational details

Typical operation

During firing, the mechanical base fuze is armed by setback and/or spin, and the pyrotechnic tracer element is ignited. The shape is designed to minimise the likelihood of deflection when hitting sloped armour, hence the blunt nose used in some designs. On impact, the fuze initiates a short delay to allow the projectile to pass through the armour before the HE charge is detonated. Despite being very small, the HE charge is sufficient to cause substantial destruction within the confines of the target's interior, and the explosive (such as the Russian A-IX-2 RDX/aluminium composition) is selected to maximise the behind-armour effects. The pyrophoric (incendiary) effects of AP-I and APSE ammunition normally result in the ignition of flammable material, such as vehicle fuel or ammunition propellant.

EOD considerations

- Demolition procedures must prevent projectiles being launched by their cartridges (or rocket motors, if present)
- Fuzes are often badly damaged during impact and may be impossible to identify
- Type identification by shape alone can be misleading
- The demolition of AP projectiles requires a large charge placed at the base of the casing
- The incendiary effects of AP-I and APSE ammunition should be considered during demolition
- Some other munitions are very similar in appearance to HE projectiles (see *Notes*).

Typical specifications

(APHE projectiles without cartridge cases or propelling charges)

Example	**BR-271**	**BR-350B**	**M65**
Country:	Russia	Russia	former Yugoslavia
Calibre:	57 mm	76 mm	100 mm
Length:	256 mm	275 mm	362 mm
Weight:	1.5 kg (est)	5 kg (est)	16.84 kg
Explosive weight:	40 g (est)	50 g (est)	64 g
Explosive type:	RDX/Al	RDX/Al	RDX/Al

Notes

National colour codes for cannon projectiles and Russian projectile markings are included in the *Identification* section.

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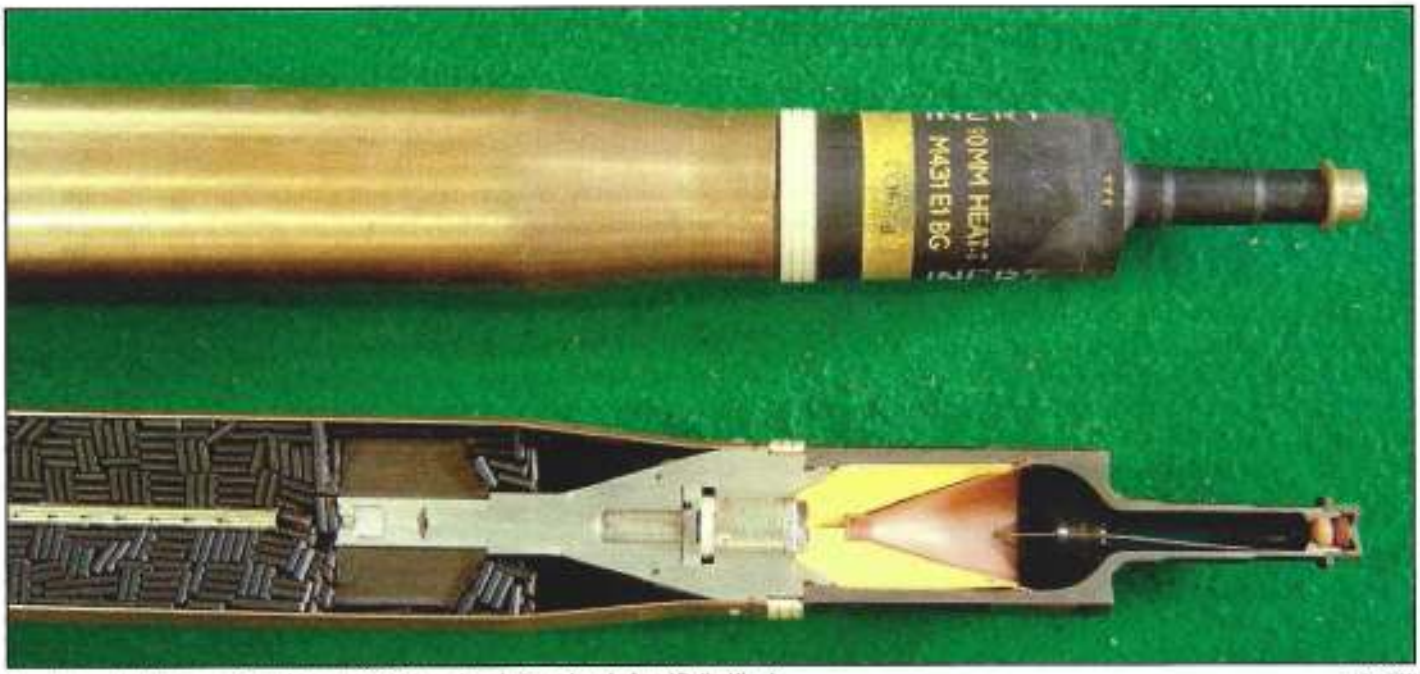
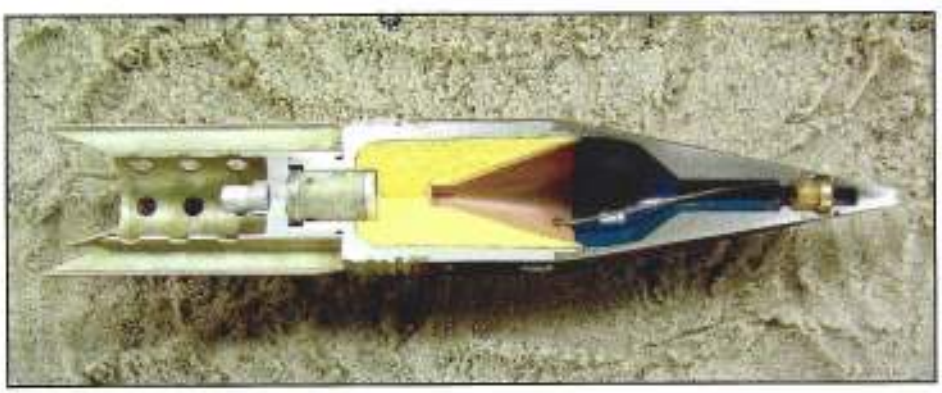


The 90 mm M431 has a fin-stabilised HEAT round and piezoelectric fuze (Colin King) 1041037

The original HEAT round for the 84 mm Carl Gustaf (Colin King) 1041036

A Russian 100 mm BK-5M fin-stabilised HEAT round with piezoelectric nose element (Colin King) 0573802

The 100 mm Yugoslav M88 HEAT round (Colin King) 1375748



90 mm HEAT projectile (Colin King) 1310492

HIGH EXPLOSIVE PROJECTILES – HEAT

Description

High Explosive Anti-Tank (HEAT) projectiles are normally produced in tank and anti-tank gun calibres (76-125 mm). HEAT munitions incorporate one or more shaped charges using the Munroe Principle to penetrate armour. The explosive charge is situated to the rear of the projectile body, behind a conical liner, normally made from copper. The open end of the cone is covered by a hollow nose section, which also creates the stand-off needed for the shaped charge to function efficiently. Older HEAT munitions often have a characteristic probe to give adequate stand-off; modern designs tend to have a more normal shape and are not so distinctive, although the ogive may be noticeably longer. The charge must be initiated from the rear using a base detonator; this may be initiated by an inertia base fuze, although nose-mounted fuzes are also used. Nose fuzes use piezoelectric elements connected to electric detonators, or 'spit-back' initiators; these are sometimes known as Point-Initiating Base-Detonating (PIBD) fuzes. Since high spin rates degrade the performance of the shaped charge, HEAT projectiles sometimes have slipping obturating rings. Some projectiles have stabilising fins and are easily confused with mortar bombs or rockets.

Several types of 'smart' gun-launched guided projectiles are now in service; these include Anti-Tank Guided Weapons (ATGW) fired from tank guns and artillery rounds, such as the Russian 'Kitolov' and 'Krasnopol'. Like missiles, they have fins that deploy after firing and tend to incorporate HEAT warheads towards the rear of the projectile. Prior to firing, these rounds are easily confused with conventional ammunition. Some munitions incorporate a small 'precursor' HEAT charge in front of the main warhead to increase penetration or defeat Explosive Reactive Armour (ERA); these 'tandem' warheads often (but not always) have a distinctive extension or probe to house the first charge.

Operational details

Typical operation

Fuzes are generally armed by setback during firing, and function immediately upon impact. Piezoelectric fuzes may be connected to the detonator using wires or insulated portions of the munition casing itself. 'Spit-back' initiators use a pyrotechnic or detonating composition to flash across the air gap between the nose fuze and the base detonator, with a flash receptor housed behind a small hole in the apex of the cone. On detonation, the shaped charge liner is formed into a focused high-velocity jet which, typically, will penetrate more than 400 mm of armour. Some fuzes incorporate a self-destruct feature, which is designed to detonate the projectile after a few seconds, if the primary fuzing system fails to function.

EOD considerations

- Demolition procedures must prevent projectiles being launched by their cartridges (or rocket motors, if present)
- Fuzes are often badly damaged during impact and may be impossible to identify
- Some 'tandem' projectiles incorporate two HEAT warheads
- Partially impacted piezoelectric fuzes may be in a sensitive condition
- Unburned base-bleed units and rocket-assist motors are an additional hazard
- Type identification by shape alone can be misleading
- Some other munitions are very similar in appearance to HE projectiles (see Notes).

Typical specifications

(HEAT projectiles without cartridge cases or propelling charges)

Example	**BK-5M**	**Carl Gustaf**	**M431**
Country:	Russia	Sweden	USA
Calibre:	100 mm	84 mm	90 mm
Length:	635 mm	360 mm	550 mm (est)
Weight:	12.38 kg	2.3 kg	6 kg (est)
Explosive weight:	1.038 kg	400 g	544 g
Explosive type:	RDX/wax	RDX/TNT	RDX/TNT

Notes

Some types of mortar ammunition and rocket look very similar to projectiles and are easily misidentified. National colour codes for cannon projectiles and Russian projectile markings are included in the *Identification* section.

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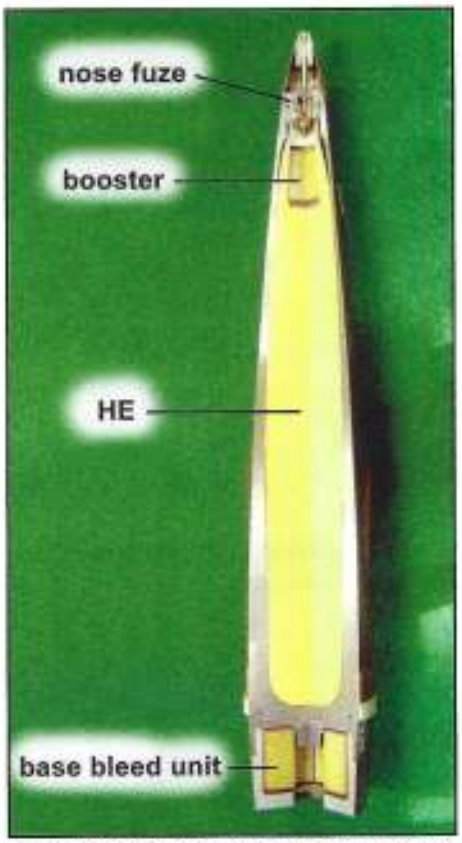
The Russian 125 mm OF-19 FRAG-HE(FS) projectile with fuzes: point-detonating (left) and delay (right) (Colin King) 0074227

South African 155 mm M1A1 projectile. Note the nubs on the rear half of the shell (Colin King) 1279553

Typical fragments from the detonation of a projectile (Colin King) 1041038



Cutaway of a typical HE fragmentation projectile (Colin King) 1121150

A Second World War German 15 cm projectile (Colin King) 1330192

The 155 mm M107 is probably the most widely used NATO artillery projectile and has been produced by more than 20 countries. This example is Yugoslav manufactured (Colin King) 1041039

HIGH EXPLOSIVE PROJECTILES – HE FRAGMENTATION

Description

HE fragmentation projectiles tend to have thick steel bodies (sometimes forged steel) with a bulk fill, often TNT or Composition B. The nose generally incorporates a threaded fuze well, behind which is a booster charge; during transit, the nose well is sealed with a plug, which may also incorporate a lifting ring. Point detonating (impact) nose fuzes are most common, though other types (including base fuzing and short delay) may be used for special purposes. Most modern ammunition is filled with TNT or a composition of RDX and TNT, but projectiles filled with Ammonium Nitrate compositions (such as Amatol), Picric Acid, and even gunpowder, are still found. Some of these older projectiles contain separate fragments, or 'shrapnel', designed to be scattered or projected forwards by the explosive filler. Smaller calibre ammunition tends to be 'fixed', with the projectile fitted into the cartridge case until it is fired. Larger calibre projectiles (typically 125 mm and above) tend to be loaded separately from the propellant charge due to their size and weight. Some of the larger projectiles can be fitted with Rocket-Assist (RA) or Base-Bleed (BB) units to extend their range. Extended Range Full Bore (ERFB) ammunition tends to be very streamlined, tapering from the driving band to the nose in a continuous ogive. In order to provide stability in the barrel, this ammunition has long mild steel 'nubs' welded to the rear half; these ride against the inside of the bore and are angled to approximately match the rotation. Projectiles used in smooth-bore guns are often fin-stabilised, which may lead to their misidentification as rockets.

Operational details

Typical operation

On firing, the fuze arming sequence is initiated and any extended range system (base bleed unit or rocket motor) ignited. Fuzes are generally armed by setback and/or spin during firing, and most function on impact or after a very short delay. Delay fuzes may be mechanical, electronic or pyrotechnic, with delays ranging from microseconds to minutes. Very short delays are most common, allowing the projectile to penetrate the earth or target before detonating. Proximity fuzes are electronic and are often set using a hand-held programmer; these allow the projectile to detonate just above the target area to maximise the lethality of the fragmentation. On detonation, the casing of an HE fragmentation projectile is shattered into shards travelling at high velocity in all directions.

EOD considerations

- Demolition procedures must prevent projectiles being launched by their cartridges (or rocket motors, if present)
- Fuzes are often badly damaged during impact and may be impossible to identify
- Partially impacted fuzes may be in a sensitive condition
- Unburned base-bleed units and rocket-assist motors are an additional hazard
- Role identification by shape alone can be misleading
- In most cases, demolition charges should be placed against the ogive
- Some other munitions are very similar in appearance to HE projectiles (see *Notes*).

Typical specifications

(HE projectiles without cartridge cases or propelling charges)

Example	**OF-19**	**M107**	**M106**
Country:	Russia	US/former Yugoslavia	USA
Type:	HE/frag tank shell	HE/frag artillery	HE/frag artillery
Calibre:	125 mm	155 mm	203 mm (8 in)
Length:	670 mm	605 mm	892 mm
Weight:	23 kg	44 kg	93 kg
Explosive weight:	3.15 kg	6.6 kg	17.6 kg
Explosive type:	TNT	TNT	RDX/TNT

Notes

Some types of mortar ammunition and rocket look very similar to projectiles and are easily misidentified. National colour codes for cannon projectiles and Russian projectile markings are included in the *Identification* section.

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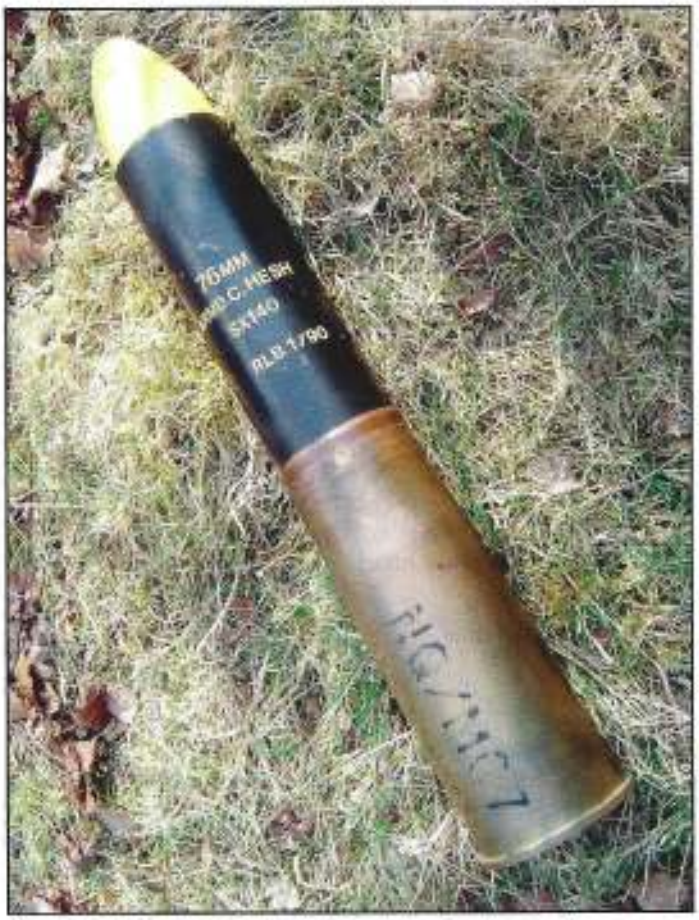

The British 76 mm L29 HESH round (Colin King) 1041041

The US 105 mm M393A2 HEP-T (HESH) tank round (Colin King) 1375747

The US M346A1 HEP-T (HESH) round for the 106 mm recoilless gun (Colin King) 1041040

The Yugoslav 105 mm M67 HESH projectile (George Zahaczewsky) 1041042

HIGH EXPLOSIVE PROJECTILES – HESH

Description

High Explosive Squash Head (HESH) projectiles are used primarily in tank and anti-tank guns for the destruction of armour, although they are also effective for the demolition of other hard targets, such as bunkers. HESH is also sometimes known as High Explosive Plastic (HEP), particularly in the US. Most HESH projectiles have a parallel-sided casing made from malleable steel, and a rounded nose section (the Yugoslav M67, with its pointed nose, is a notable exception). Internally, the casing is thick at the base and tapers forward to the nose, where it is relatively thin. The tip of the nose section is filled with an inert wax and the remainder of the warhead with a de-sensitised explosive, such as RDX/wax composition. HESH rounds are always fitted with short-delay base fuzes, and (since they are generally used in the direct role) often incorporate a tracer pocket. The presence of a tracer may be denoted by the designation, as in 'HEP-T'. HESH ammunition tends to be 'fixed', with the projectile and cartridge case assembled as a round. NATO ammunition is normally clearly marked with the word 'HESH'; yellow is used to indicate the presence of HE, while black may also be present to signify an armour-defeating munition. In the absence of markings, the rounded shape of the nose, thin casing and presence of a base fuze are indications of the role.

Operational details

Typical operation

The fuze is armed by setback and/or spin during firing and the tracer element is ignited. On impact, the base fuze is actuated, initiating the short delay; meanwhile, the projectile continues its movement, the nose flattening against the target while the wax forms a small central cavity. During this phase, it is important that the casing and explosive deform without fragmenting or initiating prematurely, hence the need for a malleable casing and an insensitive explosive composition. The fuze then detonates the explosive from the base, directing a shock wave through the roughly conical charge and into the target. Although heavy armour may not be penetrated, the shock wave tends to knock a large scab from the inside surface; this is projected at high velocity within the confines of the target and ricochets around, causing massive damage. HESH rounds may have a similar effect on other hard targets, such as concrete bunkers, while the substantial blast is effective against many other structures. Base detonating fuzes used with HESH projectiles are covered in the *Fuzes* section.

EOD considerations

- Demolition procedures must prevent projectiles being launched from their cartridges
- Fuzes are often badly damaged during impact and may be impossible to identify
- Type identification by shape alone can be misleading
- A thickness meter is useful for confirming the thin casing towards the nose
- Propellant cartridges for modern tank ammunition may use electric primers
- Since the nose of a HESH projectile has an inert filling, charges should be placed well back on the ogive.

Typical specifications

HESH projectiles without cartridge cases or propelling charges

Example	L29	M67	M346A1
Country:	UK	former Yugoslavia	USA
Calibre:	76 mm	105 mm	106 mm
Length:	334 mm	479 mm	410 mm
Weight:	5.4 kg	12 kg (est)	8 kg
Explosive weight:	600 g	3.5 kg (est)	3.5 kg
Explosive type:	RDX/wax	RDX/wax	RDX/wax

Notes

Some types of mortar ammunition and rocket look very similar to projectiles and are easily misidentified. The marking schemes used for Russian and Yugoslav projectiles are explained in the *Identification* section.

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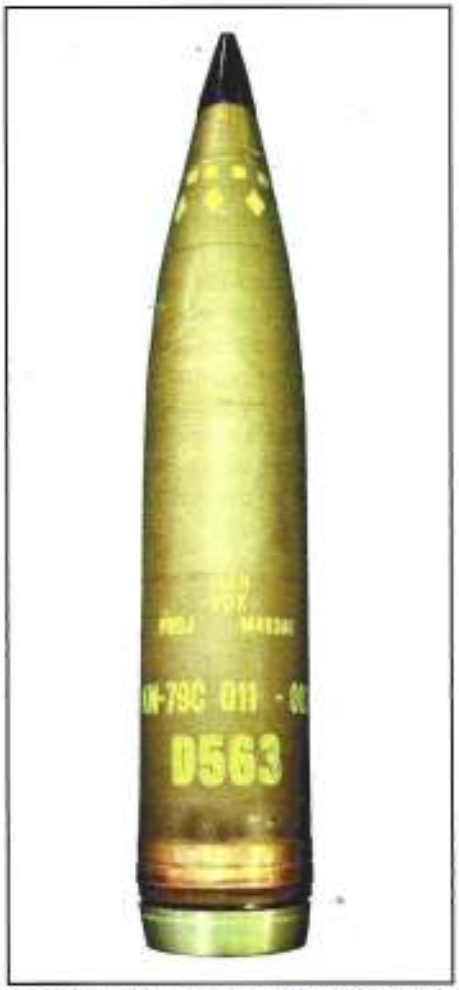
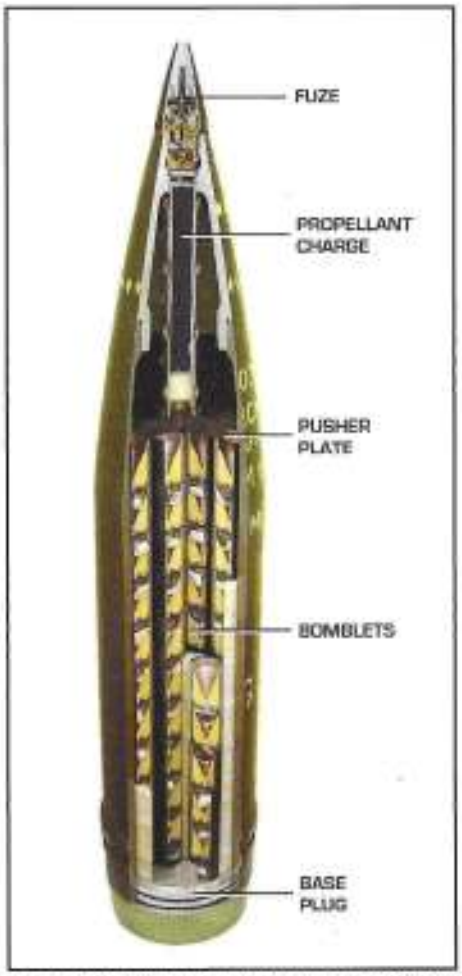


The US M483A1 carries 88 submunitions (M42 and M46), containing a total of 2.84 kg HE (Colin King) 1375768

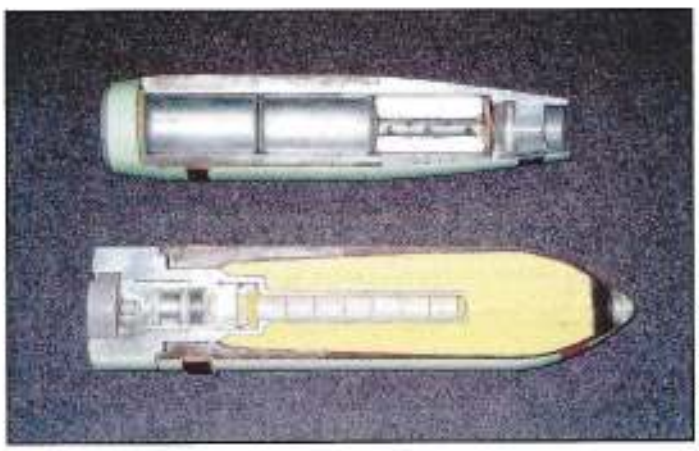


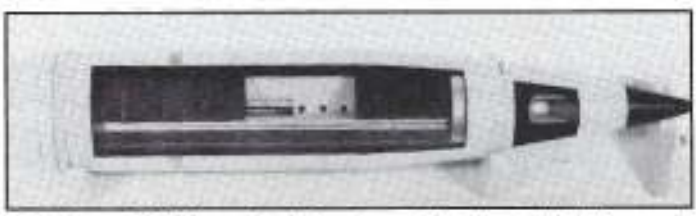
The Israeli M373 cargo projectile contains 120 M85 DPICM (Colin King) 1330185

A Russian S4Zh 122 mm base-ejection illuminating projectile (similar to the Chinese Type 54) fitted with a T-90 mechanical time fuze (Colin King) 0074243

Cutaway Bulgarian 152 mm carrier projectile containing a radio jammer (T J Gander) 0021776

A cross section of the Israeli M373 cargo projectile, showing the arrangement of the DPICM (Colin King) 1121144





The 155 mm M825A1 contains 116 wedges of felt saturated in WP 0502401

Top: 105 mm M84 BE smoke. Bottom: 120 mm bursting WP smoke (Colin King) 0532018

CARRIER PROJECTILES

Description

Any shell designed to dispense a payload is known as a 'carrier' or 'cargo' projectile. Older carrier projectiles were sometimes recognisable by their relatively parallel sides, but modern types tend to have the same streamlined profile as other types of shell, making identification reliant on markings and fuzing. Carriers are normally nose-fuzed, using a delay (mechanical, pyrotechnic or electronic) or proximity fuze, although impact fuzes are also used in projectiles with bursting charges. Payloads may include smoke mixtures, red or White Phosphorus (WP), flares or illuminants, incendiaries, chemicals, propaganda, radio echo 'chaff', submunitions or radio jamming transmitters. Most submunition carriers dispense Dual-Purpose Improved Conventional Munitions (DPICM) such as the US M42, M46 and M77 and the Israeli M85 'Bantam' (see separate entries on DPICM). The potential presence of submunitions makes it particularly important that munition identification is correct and that disposal procedures ensure that bomblets are not scattered during demolition. The payload can be nose-ejected (NE), base-ejected (BE) or dispersed using a bursting charge. Ejection charges are normally propellants (such as Black Powder), located immediately behind the fuze. Bursters are HE charges, and tend to be housed in a central tube running most of the length of the projectile; they are normally used with phosphorus (which functions as a combination smoke and incendiary) and chemical fills. Since the majority of carriers use either NE or BE, they tend to be visibly empty if they have functioned correctly. Carrier projectiles may be fitted with base bleed or rocket-assist units to extend their range.

Operational details

Typical operation

As the projectile is fired, the fuze is armed by setback and/or spin. Bursting carrier projectiles generally function on impact, the central HE charge detonating to shatter the casing and disperse the filling. Phosphorus ignites spontaneously as it passes through the air, producing a combination of smoke and incendiary effects. Ejecting carriers normally use delay or proximity fuzes to initiate the ejection charge, which is generally located immediately to the rear of the fuze. In a typical BE system, the ejection charge ignites to create pressure on a piston or pusher plate; as the payload begins to move, shear pins, screws, or the threads retaining the base plate fail, allowing the payload to be driven out of the projectile casing. The M825A1 WP projectile is unusual in that it uses both an ejection charge (to expel a canister), and an HE burster charge (within the canister). Since the projectile is spinning, multiple items (such as submunitions) are further dispersed by centrifugal force and continue to spin. The base plate is often weighted or drilled eccentrically, so that it spins away from the path of the payload. The footprint produced by submunitions is determined by a number of factors, including the velocity and trajectory of the projectile, rate of spin, opening height and wind conditions. Delay fuzes may be mechanical, electronic or pyrotechnic, with delays usually between three and 90 seconds. Proximity fuzes are electronic and are often set using a hand-held programmer.

EOD considerations

- Demolition procedures must prevent projectiles from being launched by their cartridges (or rocket motors, if present)
- It is usually apparent (from the empty casing) when a carrier projectile has functioned
- If the fill cannot be identified, the 'worst case' must be anticipated
- Fuzes are often badly damaged during impact and may be impossible to identify
- Proximity fuzes should not be approached from the front
- Particular care must be taken to avoid 'kick-outs' during the demolition of submunition carriers
- Kick-outs, caused either by demolition or ejection on impact, may be in a hazardous condition
- Unburned base-bleed and rocket-assist motors are an additional hazard
- Fill identification by shape alone can be misleading
- Phosphorus-filled munitions need special precautions and are likely to start fires in areas of dry vegetation.

Typical specifications

Example	Israeli M373	Russian S-463	US M483A1	US M825A1
Calibre:	203 mm	122 mm	155 mm	155 mm
Payload:	120 submunitions (M85)	Illuminating	88 submunitions (64 × M42 and 24 × M46)	116 wedges soaked in 5.78 kg of WP
Length:	1115 mm	545 mm	899 mm (unfuzed)	899 mm (fuzed)
Weight:	94.3 kg	22.5 kg	46.5 kg	46.7 kg
Ejection:	Base	Base	Base	Base plus HE burster (21.2 g Comp A5)

Notes

A payload of mines or submunitions can give a carrier projectile an explosive content equivalent to an HE shell. Charges must be placed to ensure the complete destruction of the payload, particularly where 'kick-outs' might result in armed submunitions or mines. When the fuzing fails, the ejection charge sometimes functions on impact, which can burst the projectile casing and partially disperse the payload. Some types of mortar ammunition, rockets and gun-launched Anti-Tank Guided Missiles (ATGM) look very similar to projectiles and are easily misidentified.

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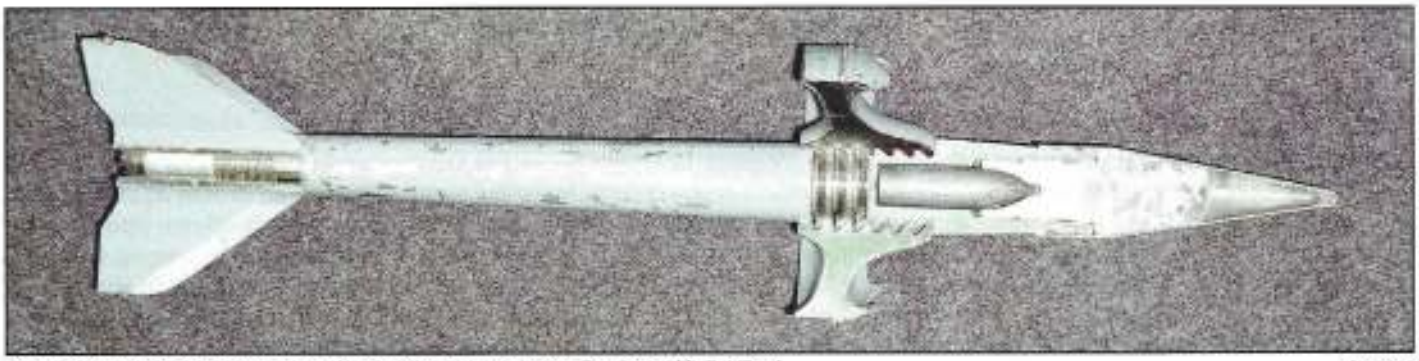
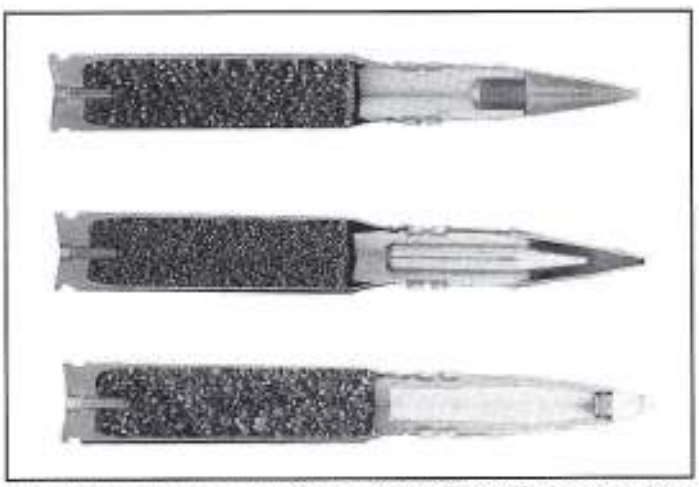


A sectioned Russian BM15 penetrator, showing the tungsten-alloy insert (Colin King) 0074242

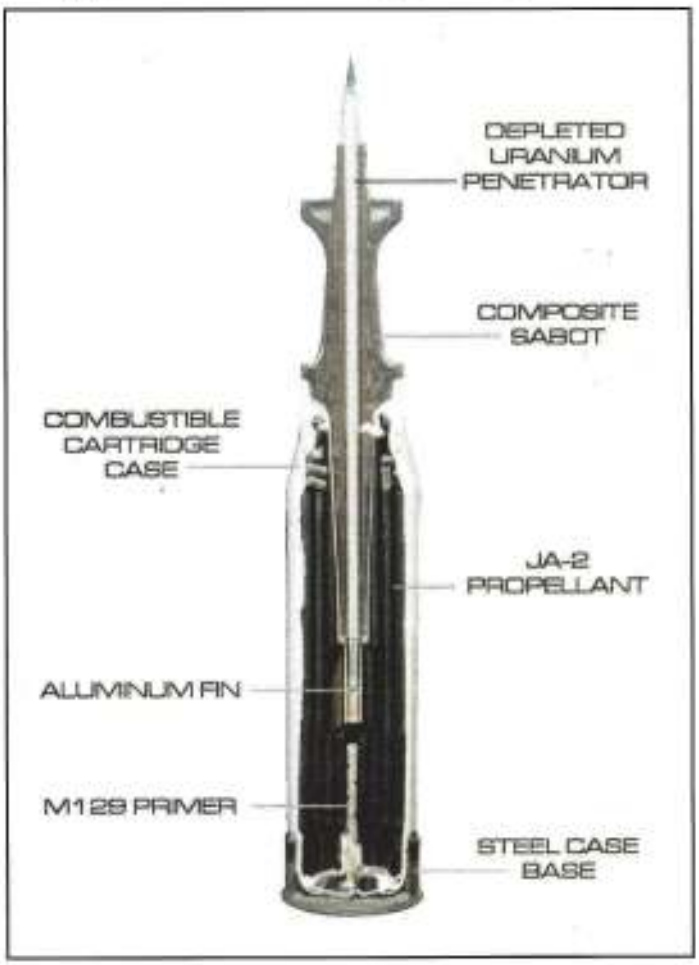
Aluminium sabots from 30 mm DU ammunition in Kosovo; these indicate a DU danger area (Colin King) 0074228

Kinetic projectiles. Solid shot (left), with penetrators from the British L15 APDS (right) and Russian BM9 APFSDS (top) (Colin King) 0074233

A typical APFSDS projectile in its sabot (British 120 mm L23) (Colin King/DEODS) 0074722



Primex 30 mm cannon ammunition; the PGU-14/B round in the centre shows the DU penetrator in its aluminium sabot 0002236



The US M829A2 tank round uses a DU penetrator (General Dynamics) 1121143

A 20 mm APDS round with plastic sabot (Colin King) 1310484

KINETIC ENERGY PROJECTILES

Description

Kinetic energy projectiles are normally fired from cannon, tank and anti-tank guns. Older varieties often had conventional projectile profiles, but were made from solid steel and known as 'shot'. Later versions used smaller projectiles housed in a sabot, and were usually made from a harder and denser tungsten alloy; these are known as Armour-Piercing Discarding Sabot (APDS). Recently, the trend has been towards tank-fired Armour-Piercing Fin-Stabilised Discarding Sabot (APFSDS) dart-shaped projectiles, sometimes known as 'long-rod penetrators'. These APFSDS rounds are designed for high sectional density (typically around 30:1) and are fired at very high velocities. Many of these projectiles have tungsten alloy penetrators (sometimes set into a steel dart), but some are made from Depleted Uranium (DU). Tungsten and DU are substantially denser than steel, both having relative densities of more than 19, compared to less than 8 for steel. Larger calibre DU APFSDS rounds are generally used in tank guns, while cannon ammunition (mostly 20, 25 and 30 mm) is fired from aircraft and infantry fighting vehicles. Penetrators often have ballistic caps and are generally fitted with tracer elements. Tracers can be mistaken for base fuzes, particularly in old-shape solid shot that are badly corroded. In the unfired round, a penetrator protruding from a sabot could also be confused with the probe of a High Explosive Anti-Tank (HEAT) round. Conversely, a ballistic cap covering a penetrator can create the appearance of an HE projectile. Solid shot normally have conventional copper driving bands, while sabot rounds (particularly those used in smooth-bore tank guns) often have plastic obturating rings.

Operational details

Typical operation

Smaller kinetic projectiles are used in 'fixed' ammunition, while large calibres (normally 120 mm or more) may be 'separate' and use bag charges or Combustible Cartridge Cases (CCCs). Some Russian rounds have an APFSDS penetrator surrounded by propellant and enclosed in a CCC (see photograph in the *Projectiles – general* entry). Solid shot are generally fired from a rifled barrel and follow a normal ballistic trajectory to their target. Sabot rounds are fired at very high velocities (typically around 1,700 m/s), giving them a flat trajectory and (since kinetic energy is proportional to the square of velocity) substantial penetration. In most cases, the sabot is discarded the moment the round leaves the barrel and will not, therefore, be found near the penetrator. Some older ammunition used sabots in the form of pots, while virtually all modern large-calibre sabots break into sections from around the central rod. A penetrator is partially consumed during its passage through armour; shavings and dust from the DU ignite to give an additional pyrophoric effect, but also create a toxic and low-level radiation hazard.

EOD considerations

- Demolition procedures must prevent projectiles from being launched by their cartridges
- The presence of DU should be established before EOD work commences on a clearance site (see *Notes*)
- Personnel working in DU strike areas should be adequately protected from potentially radioactive and toxic dust
- X-ray examination may be needed to distinguish between tracers and base fuzes in badly corroded solid shot
- Precautions must be taken to protect CCCs and propellant from sources of ignition
- Modern tank ammunition cartridge cases may use electrically initiated primers
- Some APHE projectiles are easily confused with solid shot.

Typical specifications

projectiles without cartridge cases

Calibre	**30 mm**	**76 mm**	**120 mm**	**125 mm**
Example:	US PGU-14/B	US M464	US M829A2 'Silver Bullet'	Russian BM9
Fired from:	A10 aircraft cannon	Light vehicle cannon	Tank guns	Tank guns
Material:	DU	Tungsten alloy	DU	Hardened steel
Penetrator length:	140 mm	309 mm	780 mm	409 mm
Penetrator weight:	425 g (with sabot)	1.63 kg (without sabot)	7.9 kg (without sabot)	3.6 kg (without sabot)

Notes on Depleted Uranium

DU is mildly radioactive (primarily an alpha emitter) but was originally considered to be relatively harmless. However, on impact, the highly toxic compound Uranium Oxide is also formed as a fine dust, which is easily ingested or inhaled. There is now widespread concern over the use of DU, which is believed to be a toxin acting as an endocrine disruptor, and a carcinogen from both its chemical and radiological properties.

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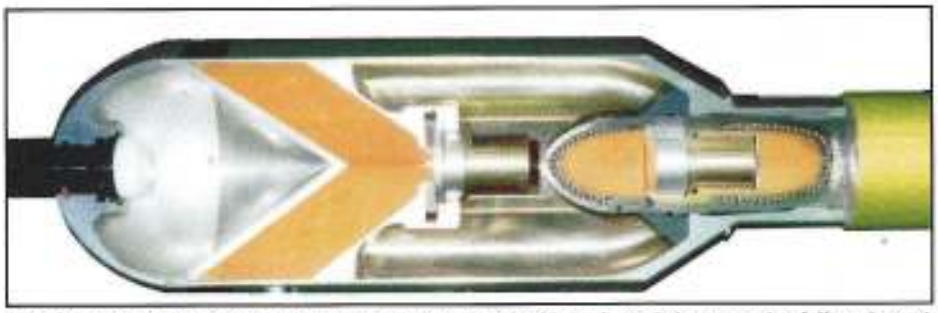
The US M28 3.5 in HEAT rocket (Colin King) 1310523

The presence of a venturi is a prime characteristic of a rocket (68 mm SNEB) (Colin King) 0074724

The Israeli/Romanian LAROM 160 is a typical artillery Multiple Rocket Launcher (MRL) 0073645

RPO-A is a Russian shoulder-launched rocket with a 2 kg thermobaric (FAE) warhead (Colin King) 0673805



The German 'Bunkerfaust' has an advanced warhead with a shaped charge and a follow-through fragmentation grenade (Colin King) 0573804

A Bulgarian PG-7M HEAT rocket for the RPG-7 (Colin King) 1330391

ROCKETS

GENERAL

Description

Rockets come in an enormous range of sizes and functions, from the familiar shoulder-launched Rocket Propelled Grenades (RPG) to large surface-to-surface artillery rockets, including the many types of Multiple Rocket Launcher (MRL). Rockets are unguided; those rocket-propelled munitions that incorporate in-flight guidance systems are defined as missiles. Other than the absence of a guidance system, the main characteristic of a rocket is the presence of a propellant motor, which normally has one or more visible venturis. Older rocket motors generally contain single-based or double-based propellants, while modern versions tend to use composite propellants. Rockets typically have a nose-mounted fuze with the warhead directly behind; the motor is located behind the warhead, with venturis at the rear of the munition. The most notable exception to this layout is the much-copied Russian PG-7 round, which has side-mounted venturis positioned towards the front of the rocket motor. The distinction between rockets and missiles is particularly significant to the EOD technician because missiles frequently have a guidance system mounted in the nose of the munition, with the warhead behind, towards the mid-section. The majority of land-service rockets have High Explosive (HE fragmentation, HEAT and tandem) or submunition warheads, with 'thermobaric' rounds also becoming more widespread. Air-launched rockets can have a wide variety of optional warheads.

Operational details

Typical operation

Most rockets are fired from smooth tubes, although a few of the larger types are launched from rails. Some smaller rockets, such as shoulder-mounted RPG, use a conventional trigger-operated mechanism to strike a percussion cap, but larger and more modern rockets tend to use electrical initiation. The percussion cap or electric squib ignites the propellant grain inside the rocket motor, which then burns continuously until all of the propellant has been consumed. The motor casing is basically a pressure vessel, vented to direct the propellant gas through one or more venturis. The effect of the venturi is to direct and accelerate the propellant gas to maximise thrust as it exits the casing. Fins normally provide stability in flight and may also be used to impart a relatively slow spin; tube-launched rockets generally have folding fins that deploy as they leave the tube. To avoid excessive tube pressures and to prevent the rocket efflux from injuring the firer, shoulder-launched rockets tend to use a small 'kick-out' charge to eject the munition before the rocket motor ignites. Most warheads are impact-fuzed, but some also incorporate a pyrotechnic self-destruct delay. HEAT warheads must be initiated from the base, but may use either a base inertia fuze or a nose-mounted fuze combined with a base initiator. Nose-mounted fuzes for use with HEAT warheads tend to have either a piezo element connected to an electric base detonator or a spit-back nose fuze and a flash-receptive base detonator.

EOD considerations

- It is important not to confuse a rocket with a missile during initial reconnaissance
- The location of explosive components should be verified before demolition
- Demolition procedures must destroy venturis to prevent unfired rockets from being launched
- Fuzes are often badly damaged during impact and may be rendered highly sensitive
- Unburned propellant may be capable of detonation under some circumstances (see *Notes*)
- Type identification by shape alone can be misleading; in some cases, it is not possible at all
- Particular care is needed where a submunition fill is suspected.

Approximate range of specifications

	Shoulder-launched	Air-to-surface	Artillery rockets
Calibre:	40–90 mm	37–240 mm	51–425 mm
Length:	0.6–1.2 m	0.6–4 m	1–5.6 m
Weight:	1.8–5 kg	1–70 kg	5–850 kg
Explosive weight:	0.5–3 kg	0.3–10 kg	1–300 kg

Notes

Conventional propellant may burn extremely rapidly or detonate during demolition, particularly when it has deteriorated over time or has been shattered by an impact. Composite propellant (made using fuel and oxidant, or HE, bound into a polymer matrix) may detonate if the critical diameter is exceeded. See separate entries in this section for details of different rocket types; see also the national production tables for air-launched rockets in the *Data summary* section.

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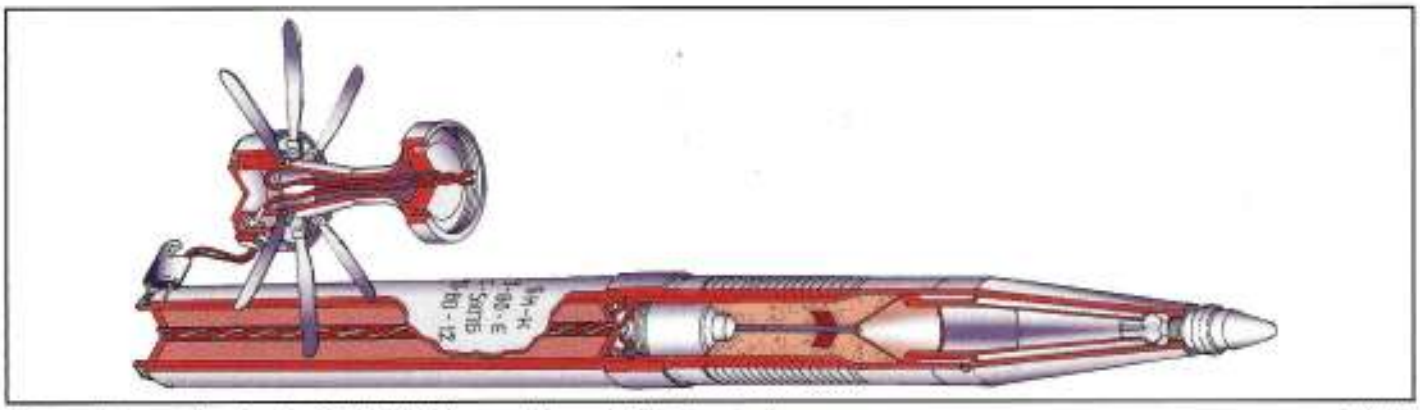
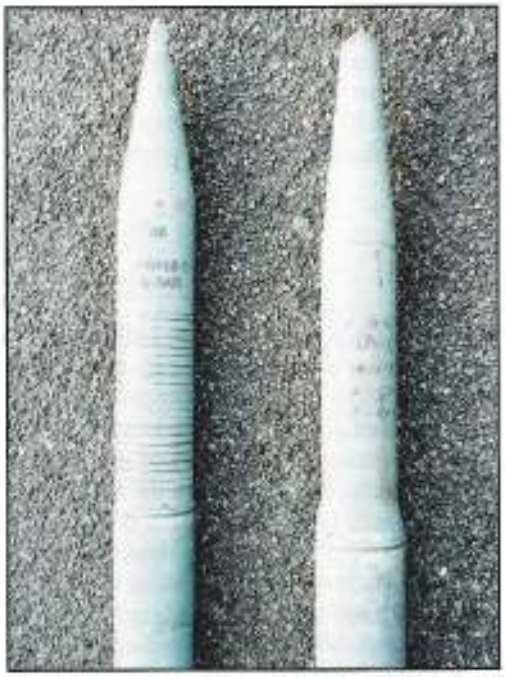


Cutaway diagram of the Russian S-5KPB HEAT/fragmentation rocket (Lyn Haywood) 0532023



Russian 80 mm S-8 warheads. S-8KO (left) is HEAT/fragmentation, S-8B (right) is a penetrator containing a small HE charge (Colin King) 0074260

Russian 57 mm S-5KO rockets with HEAT/fragmentation warheads (Colin King) 0074249

Russian 57 mm rockets. From the left: S-5KP, S-5KO, S-5K, S-5M (Colin King) 1310624

Obsolete British 2-inch rocket (left) and 68 mm SNEB (right), showing the change in rocket colour codes (Colin King/DEODS) 0074723

Cutaway French 68 mm 'SNEB' rockets with HEAT and HE-fragmentation warheads. Note the piezo nose fuze and clockwork arming delay at the rear of the warhead (Colin King) 1041043

Russian UB-32-57 and UB-16-57 pods for S-5 rockets. The first number indicates the number of tubes; the second the calibre (Olly Allerhead) 1330392

AIR-LAUNCHED ROCKETS

Description

Most types of air-launched rocket are fired from pods, which have a matrix of launch tubes and a sequential initiation system. A few rockets, such as the Swiss 81 mm SURA-D, are launched from racks or rails. It is common for a standard calibre motor to accept a variety of optional warheads, which tend to be externally similar and are not, therefore, readily identifiable by shape. HE fills are most common, and may include HEAT, tandem HEAT, HE fragmentation, HEISAP (High Explosive Incendiary Semi-Armour-Piercing) and armour-piercing HE warheads. Other warhead varieties include target practice markers, fuel-air explosive or 'thermobaric', kinetic penetrators and carriers containing flechettes, flares, smoke, chaff and submunitions. Rocket layout is generally conventional, with the warhead mounted ahead of the rocket motor and venturis clearly visible on the base of the rocket motor. In most cases, the profile of the warhead gives no indication of the type; HEAT charges, for example, may be located well back from the nose (see images). Most types are fin-stabilised, with folding or spring-loaded fins mounted towards the rear of the motor. Older systems (such as the French SNEB and Russian S-5 and S-8 series) tend to use single-base or double-base propellant, while more modern rockets (such as the Canadian CRV7 70 mm series) use newer composite propellants, such as HTPB (Hydroxy-Terminated Polybutadiene Binder).

Operational details

Typical operation

Multiple air-launched rockets are electrically initiated in a rapid sequence in order to fire a salvo into a target area. Rocket motors are normally single-stage and burn violently for a short time (typically 2 to 5 seconds) to accelerate the rocket to supersonic speed. Fuzes tend to be inertia-armed and generally incorporate a short arming delay. Most HE warheads are designed to detonate on impact, and are fitted with Point-Detonating (PD) nose fuzes. HEAT warheads must be initiated from the base, but may use either a base inertia fuze or a nose-mounted fuze combined with a base initiator. Most nose-mounted fuzes for use with HEAT warheads have a piezo element connected to an electric base detonator, though some older types use a spit-back nose fuze and a flash-receptive base detonator. Penetration warheads are base fuzed and generally incorporate a short delay (milliseconds) to allow the munition to enter the target before detonating. Some rockets incorporate a self-destruct delay designed to detonate the warhead should it fail to strike its target.

EOD considerations

- Where possible, the warhead type should be identified before EOD action
- The presence of an unexploded air-launched rocket may indicate that others are nearby
- The location of explosive components should be verified before demolition
- It is important to establish whether rockets are fired or unfired
- Demolition procedures must destroy the venturi to prevent unfired rockets from being launched
- Fuzes are often badly damaged during impact and may be rendered highly sensitive
- Unburned propellant may be capable of detonation under some circumstances (see *Notes*).

Typical specifications

Example	French SNEB 68-253	Russian S-5K	US Hydra M261
Warhead:	HEAT	HEAT	Carrier
Calibre:	68 mm	57 mm	70 mm
Overall length:	0.91 m	1.01 m	1.74 m
Overall weight:	5 kg	4.5 kg	12.3 kg
Warhead weight:	1.8 kg	1.6 kg	6.12 kg
Warhead fill:	300 g HE	260 g HE	9 × M73 submunitions

Notes

Conventional propellant may burn extremely rapidly or detonate during demolition, particularly when it has deteriorated over time, or has been shattered by an impact. Composite propellant (made using fuel and oxidant, or HE, bound into a polymer matrix) may detonate if the critical diameter is exceeded. See also the national production tables for air-launched rockets in separate sections.

The following letters are used to designate warhead function with the S-5 (57 mm), S-8 (80 mm) and S-13 (122 mm) rockets in service with Russia and other former Warsaw Pact countries, including Bulgaria and Romania:

Suffix	Description	Suffix	Description
B	HE penetrator	**MO**	HE blast/frag
D	Fuel-air blast	**O**	Illuminating
K	HEAT	**OF**	Anti-personnel/anti-matériel
KO	HEAT/frag	**P**	Chaff or jamming
KP	HEAT/frag	**T**	Tandem HEAT
M	Modified	**Ts**	Target practice

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107 mm MRL rockets are common in Iraq and Afghanistan. This collection includes Chinese, Iranian and Russian variants (Colin King) 0573808

A Russian 122 mm BM-21 rocket in its transit crate (Colin King) 1041044

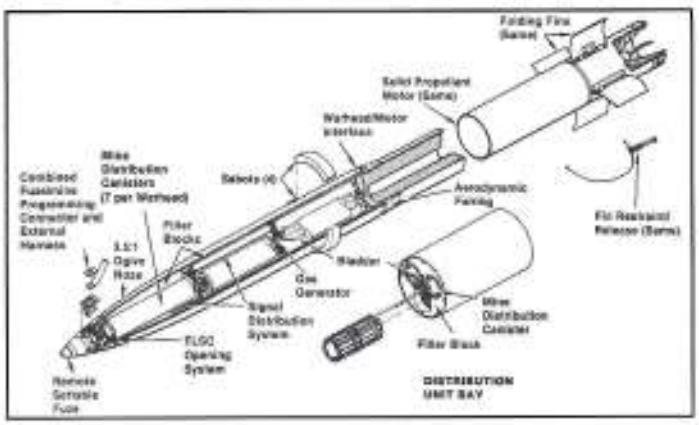
Russian 240 mm rockets for the BM-24 (Colin King) 1375795

The characteristic tail assembly of the Russian BM-21 (Colin King) 1310527

The 9M22 rocket for the Russian 122 mm BM-21 'Grad' (Colin King) 1310526

Italian FIROS 122 mm MRL rockets with HE warheads (length: 2.8 m) in Iraq. The submunition version is 3.3 m long (Colin King) 0573810

The Iranian 240 mm Falaq-1 rocket, which has been used by insurgents in Iraq, is a close copy of a Russian BM-24 rocket (Colin King) 1330393



MLRS rocket with carrier warhead containing AT-2 mines
0500656

ARTILLERY ROCKETS

Description

Most types of artillery rocket are fired from Multiple Rocket Launchers (MRL), which have a matrix of launch tubes and a sequential initiation system. Some of the larger rockets, such as the Russian FROG-7 and the Chinese Type 74 minelaying rockets, are launched from rails. Tube-launched rockets tend to have folding fins, or none at all, while those on rail-launched types tend to be fixed. Although a large variety of warheads are in use, by far the most common are HE or submunition filled. HE warhead design reflects the fact that artillery rockets are area weapons, so most are fragmentation rather than HEAT. Space and weight limitations mean that submunitions tend to be dual-purpose (anti-armour and anti-personnel), with many containing Dual Purpose Improved Conventional Munitions (DPICM) based on the US M42 design. Other types of warhead include illuminating, incendiary, smoke and practice. In many cases, the same motor may be used with a variety of different warheads, though these are factory fitted and not easily changed in the field. Tube-launched rockets are normally parallel-sided for most of their length, making it impossible to identify function or filling from the external shape alone. A conventional layout is used, with nose fuze and the warhead mounted ahead of the rocket motor; venturi are on the base of the rocket motor, with folding or spring-loaded fins – if fitted – also mounted towards the rear. Older systems (such as the Russian BM-21 'Grad') tend to use single-base or double-base propellant, while more modern rockets (such as the US Multiple Launch Rocket System [MLRS] and the Chinese 273 mm WM-80) use composite propellants, such as HTPB (Hydroxy-Terminated Polybutadiene Binder). Some, including the Russian FROG-7 and the Chinese WM-80, have an additional radial rocket motor mounted behind the warhead to impart spin during launch.

Operational details

Typical operation

Virtually all modern MRL are electrically initiated in a rapid sequence in order to fire a salvo into a target area. The motor burns violently for a short time (typically one to five seconds) and accelerates the rocket to supersonic speed, after which it follows a ballistic trajectory. As an illustration of the rocket's power, an MLRS rocket generates more than 6,000 kg of thrust, taking the 300 kg munition to a maximum range of 37 km. Artillery rockets use warhead layout and fuzing options similar to those found in projectiles. Nose fuzes are generally used, with most conventional HE warheads using Point Detonating (PD) fuzes and carriers using delay or proximity fuzes. Older systems tend to use simple mechanical fuzes, while many newer types are electronic; some (including MLRS) are powered using ram-air turbines. Fuzes may be armed, and pyrotechnic delays initiated, by set-back forces during launch; some rockets also have self-destruct devices that operate if the primary fuzing system fails to function. In addition to conventional Base Ejection (BE) and Nose Ejection (NE), some of the larger carrier rockets use central bursters or linear shaped charges to split the warhead open and dispense their cargo.

EOD considerations

- Where possible, the warhead type should be identified before EOD action
- The presence of an unexploded artillery rocket from an MRL may indicate that others are nearby
- All explosive components should be attacked simultaneously during demolition
- It is important to establish whether rockets are fired or unfired
- Demolition procedures must destroy the venturis to prevent unfired rockets from being launched
- Fuzes are often badly damaged during impact and may be rendered highly sensitive
- Special demolition methods and precautions are needed for large submunition carrier warheads
- Unburned propellant may be capable of detonation under some circumstances (see *Notes*)
- Large carrier warheads may contain linear cutting charges and/or central bursters
- Some rockets incorporate spin motors requiring separate demolition.

Typical specifications

Example	Chinese Type 63	Iranian Falaq-1	Russian BM-21	US MLRS (Phase 1)
Variant:	Type 63-II	HE frag	9M22 (HE frag)	M26 submunition
Calibre:	107 mm	240 mm	122 mm	227 mm
Overall length:	841 mm	1.32 m	2.87 m	3.94 m
Overall weight:	18.8 kg	111 kg	66 kg	307 kg
Warhead weight:	8.3 kg	50 kg	18.3 kg	156.2 kg
Warhead fill:	1.3 kg HE	20 kg HE (est)	6.4 kg HE	644 DPICM (modified M77)

Notes

The use of artillery rockets by non-state armed groups has increased dramatically in recent years; these rockets are often fired from improvised launchers, or even directly from earth banks. Conventional propellant may burn extremely rapidly or detonate during demolition, particularly when it has deteriorated over time or has been shattered by an impact. Composite propellant (made using fuel and oxidant, or HE, bound into a polymer matrix) may detonate if the critical diameter is exceeded. See also separate entries: *Artillery rocket designations and Artillery rockets – FROG series.*

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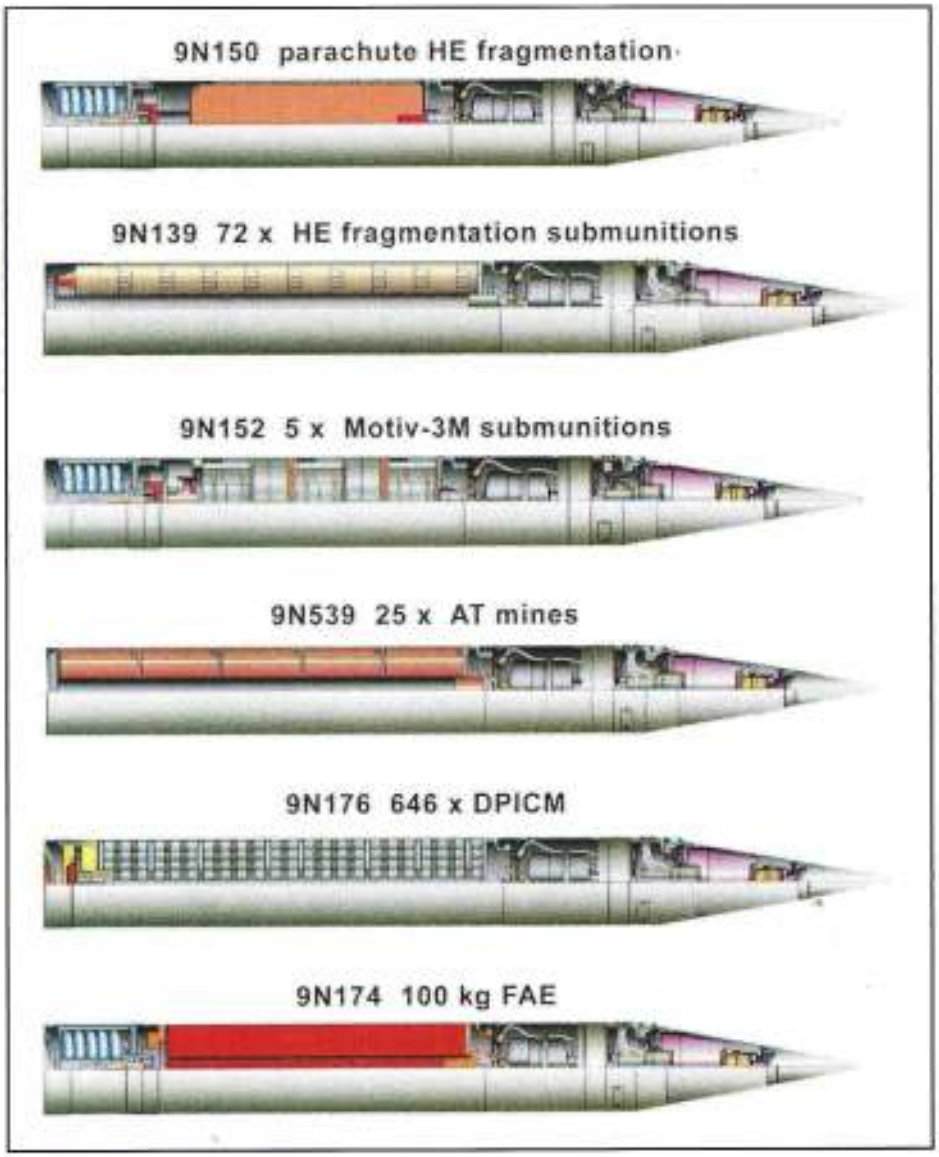
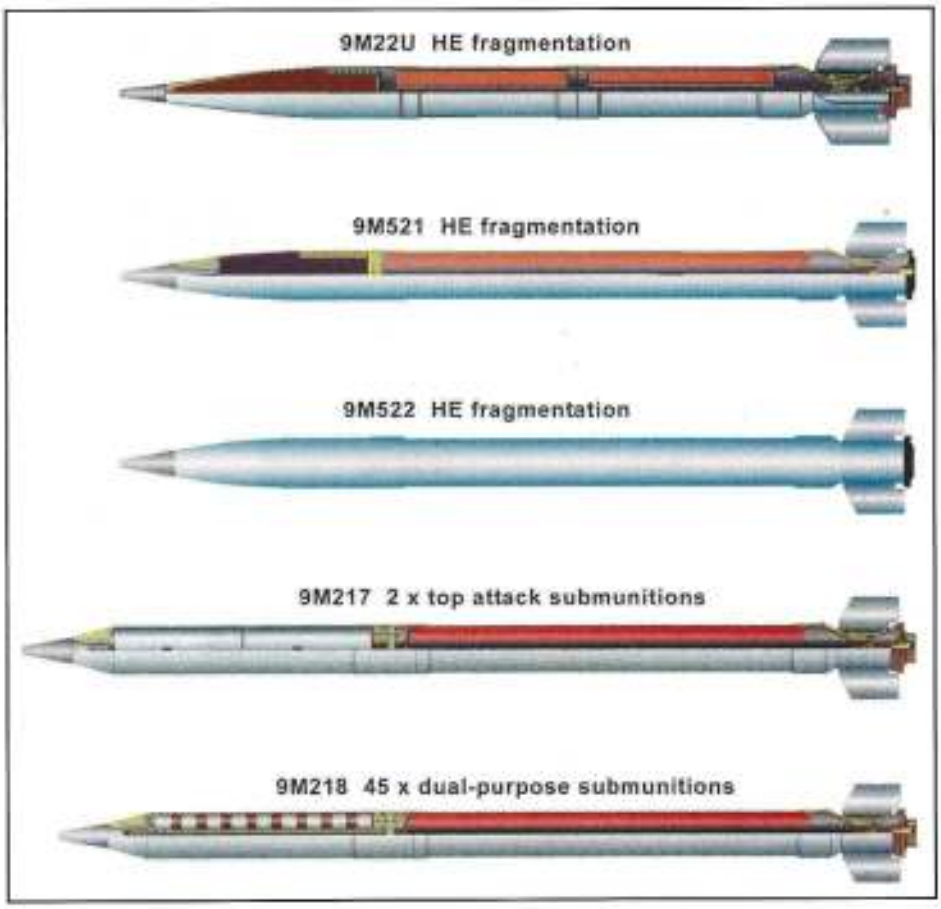

9N150 parachute HE fragmentation
9N139 72 x HE fragmentation submunitions
9N152 5 x Motiv-3M submunitions
9N539 25 x AT mines
9N176 646 x DPICM
9N174 100 kg FAE

Russian 300 mm MRL warheads
0573811


9M22U HE fragmentation
9M521 HE fragmentation
9M522 HE fragmentation
9M217 2 x top attack submunitions
9M218 45 x dual-purpose submunitions

Russian 122 mm MRLs
0573812

ARTILLERY ROCKET DESIGNATIONS

122 mm rockets

The following designations are used on 122 mm artillery rockets made in Russia and other former Warsaw Pact countries. These rockets are intended primarily for use in the BM-21 'Grad' and BM-9A51 'Prima' Multiple Rocket Launchers (MRL). These systems, and direct copies, are in service with more than 50 countries. Many other countries, including Iran and Turkey have produced rockets copied from, or similar to, Russian types.

Rocket designation	Alternate designation	Type	Content
9M18		Carrier	5 × anti-tank mine
9M22, 9M22F	M-21-OF	HE frag	6.4 kg HE
9M22M	M-21-OF	HE frag	18.4 kg warhead
9M22S	9N150	Carrier	Incendiary
9M22U	M-21-OF, DB-1B	HE frag	18 kg warhead
9M28D		Leaflet	No HE content
9M28F	DKZ-B	HE frag	19.4 kg warhead
9M28K	DKZ-B	Carrier	3 AT or 5 AP mines
9M28S		Carrier	Incendiary
9M42		Carrier	Illumination
9M43		Carrier	Smoke (5 canisters)
9M53F		Enhanced blast	26 kg parachute retarded warhead
9M217		Carrier	2 top-attack submunitions
9M218		Carrier	45 DP submunitions
9M519	Liliya-2	Carrier	Radio jammer
9M521		HE frag	21 kg HE and ball bearings
9M522		HE	Parachute retarded fragmentation warhead
9M551K		Carrier	Sensor-fuzed submunitions

220 mm rockets

The following designations are used on 220 mm artillery rockets used with the BM-9P140 'Uragan' MRL. This system has been used by Russian forces in Afghanistan and Chechnya.

Rocket designation	Warhead designation	Type	Content
9M27F	9N218F	HE frag	100 kg warhead (51.7 kg HE)
9M27K/9M27K1	9N218K1	Carrier	30 × 9N210 dual-purpose submunitions
9M27K2	9N218K2	Carrier	24 × PTM-1S AT mines
9M27K3	9N218K3	Carrier	312 × PFM-1 AP mines
9M27S	9N128S	Carrier	Incendiary
9M51	9N515	Enhanced blast	Fuel-air explosive
9M59	n/k	Carrier	9 × PTM-3S AT mines

300 mm rockets

The following designations are used on 300 mm artillery rockets used with the Russian BM9A52 'Smerch' MRL.

Rocket designation	Warhead designation	Type	Content
9M55F and 9M528	9N150	HE frag	Parachute-stabilised unitary warhead containing 92.5 kg of HE
9M55K and 9M525	9N139	Carrier	72 × 9N235 HE frag bomblets
9M55K1 and 9M526	9N152	Carrier	5 × Motiv-3M 'smart' submunitions
9M55K4 and 9M527	9N539	Carrier	25 × AT mines
9M55K5 and 9M531	9N176	Carrier	646 × DP submunitions
9M55K6	9N258	Carrier	Sensor-fuzed submunitions
9M55R		Carrier	Reconnaissance drone
9M55S and 9M529	9N174	Enhanced blast	100 kg fuel-air explosive
9M530	n/k	Penetrator	75 kg HE

Other former Warsaw Pact artillery rockets

Calibre	Rocket/launcher designation	Number of tubes	Rocket length	Rocket weight
132 mm	BM-13-16	16	1.74 m	42.5 kg
140 mm	BM-14-16, RPU-14	16	1.09 m	39.6 kg
140 mm	BM-14-17	17	1.09 m	39.6 kg
200 mm	BMD-20	4	3.11 m	194 kg
220 mm	BM-27	16	4.8 m	360 kg
240 mm	BM-24	12	1.18 m	112 kg
250 mm	BM-25	6	5.82 m	455 kg

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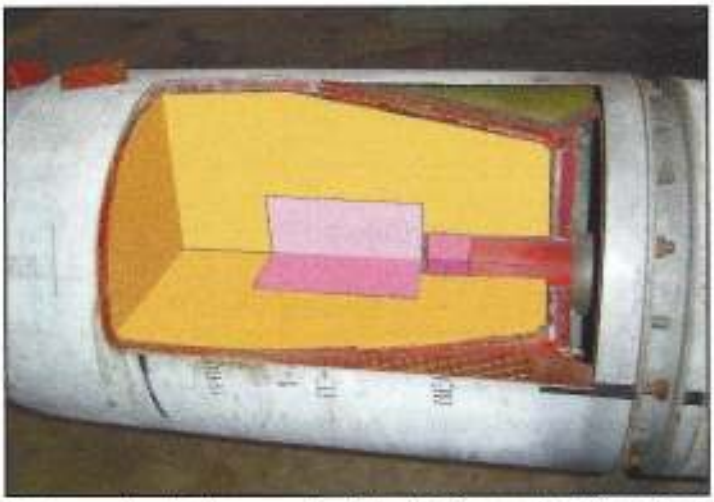
The 450 kg 9M21FTS warhead on a FROG-7 in Iraq (Colin King) 0573813

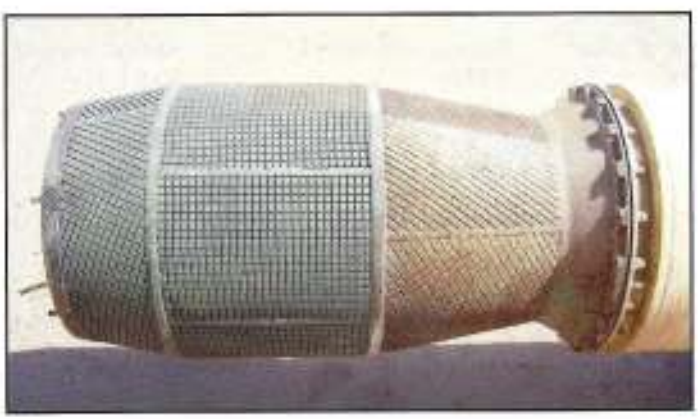
Russian FROG-7 The central venturi is the sustainer motor and the small nozzles are for the booster. A 4-venturi spin motor just behind the warhead also fires during launch (Colin King) 0573809



A cutaway showing the rear section of the HEAT/frag warhead. The casing is two layers of notched steel plate, while the tapered front section contains the conical shaped charge liner (Colin King) 1310625

450 kg shaped charge warheads (9N21F) from the FROG-7 (Ollie Allerhead) 1121141

A close-up of the FROG spin motor and venturis (Colin King) 1330390



The fragmentation casing of the 9N21F warhead (Ollie Allerhead) 1375799

ARTILLERY ROCKETS – FROG SERIES

The FROG series

The FROG (Free Rocket Over Ground) series are large ballistic rockets fired from rails fitted to dedicated launch vehicles. The series includes the following rockets:

System designation	Rocket designation	Name	Remarks
FROG-1	3R1	Filin	Introduced in 1955. Obsolete
FROG-2	3R2	Mars	Introduced in 1955. Obsolete
FROG-3	3R-8	Luna	Introduced in 1961. Still held by some countries
FROG-4	3R-9	Luna-1	Introduced in 1964. Obsolete
FROG-5	3R-10	Luna-2	Introduced in 1964. Still held by some countries
FROG-6	PV-65		Inert training model
FROG-7a	R-65A (9M21)	Luna-M (9K21)	Introduced in 1964. Still in service with several countries
FROG-7b	R-70, R-75	Luna-M (9K52)	Introduced in 1965. Still in service with several countries

The FROG-7 series

The FROG-7 system normally consists of a Transporter Erector Launcher (TEL) vehicle (on which the rocket is carried) a 4 × 4 fire control vehicle and a trailer-mounted meteorological radar. The rail-launched artillery rockets contain solid propellant and consist of a sustainer motor with a large central venturi surrounded by a booster motor with 16 small nozzles. Burn time for the motors is between 6 and 11 seconds. A spin motor is located behind the warhead and fires through angled venturi in the side of the rocket.

FROG-7 is available with the following warheads:

Rocket designation	Warhead designation	Type	Content
9M21A	9N18A	Carrier	Leaflets
9M21B	AA-22, AA-38 or AA-52	Nuclear	Selectable yield warheads ranging from 3–200 kTs
9M21D		Carrier	Leaflets
9M21E	9N18E	Carrier	42 9N22 HE Frag submunitions (see *Specifications* and *Notes*)
9M21F	9N18F	HE frag	450 kg unitary warhead (250 kg HE), incorporating a conical shaped charge and fragmentation casing
9M21FTS	9N18F	HE frag	Variant of the 9M21F intended for use in hot climates. Found in Iraq
9M21G	n/k	Chemical	Various agents may be used
9M21OF	9N18OF	Carrier	42 submunitions
9M21Ye and Yel	n/a	Training	Inert warhead

Typical specifications

Example	FROG-7a	FROG-7b	9N22 submunition
Diameter:	544 mm	544 mm	74 mm
Overall length:	8.96 m	9.4 m	540 mm
Overall weight (approx):	2,450 kg	2,450 kg	7.5 kg
Warhead weight (approx):	450 kg	450 kg	n/a
Warhead fill:	250 kg HE	250 kg HE	1.7 kg

Notes

The 9N22 submunition uses a 9E237 impact fuze with a pyrotechnic self-destruct back-up.

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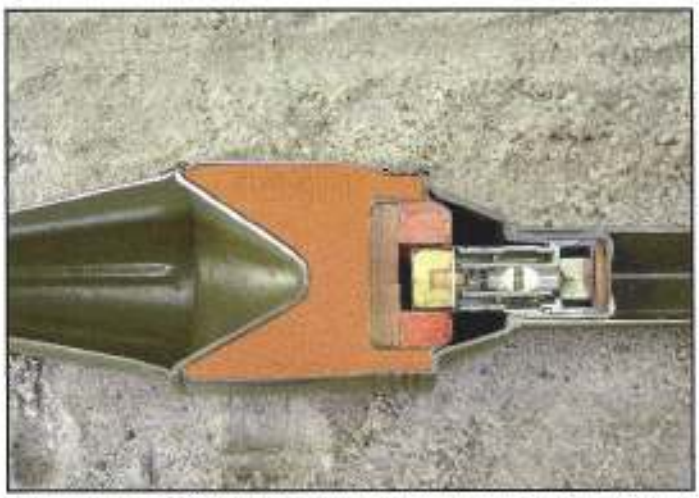
An unexploded PG-2 in Kosovo (Colin King) 0074726

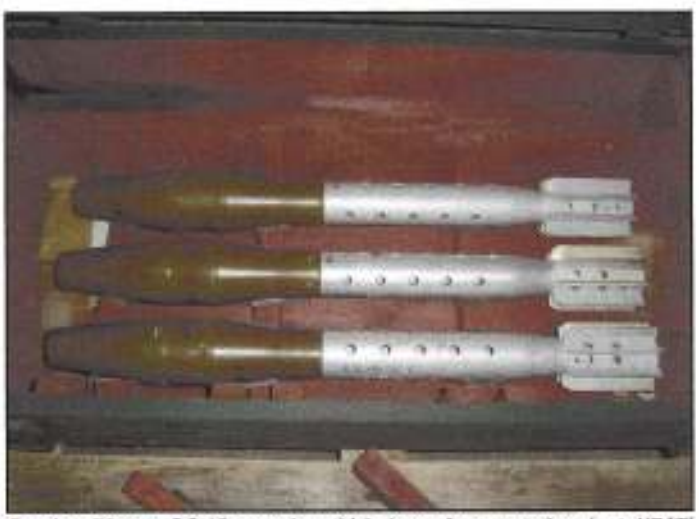
Ammunition for RPG-2: Chinese Type 50, complete with firing charge (above) and PG-2 copy (below) (Colin King) 0074247

This Vietnamese grenade uses the fragmentation warhead from a US BLU-66 bomblet; this is fitted with a mortar bomb fuze and coupled to a PG-2 tail assembly (Colin King) 0573614



Cutaway of the PG-2 warhead, showing the simple inertia fuze at the base of the shaped charge (Colin King) 1375796

A Bulgarian OG-7 projected fragmentation grenade (Colin King) 1330364



Russian 73 mm OG-15 rounds, which have fragmentation (not HEAT) warheads (Colin King) 1310522

PROJECTED GRENADES

Description

So-called 'Rocket-Propelled Grenades' (RPGs) can be divided into two categories: those that incorporate a sustainer rocket motor and those that do not. This entry deals with the latter, while *Rocket-propelled grenades* are dealt with in a separate entry. Although many types are superficially similar, projected grenades are distinguished from RPGs by the absence of any venturis.

Projected grenades are fired from the same types of launcher (such as the RPG-2 and RPG-7) as RPGs, but are propelled solely by propellant burned within the launch tube. This means that they have significantly less range than an RPG with an equivalent payload. The range and payload limitations have made most projected grenades redundant on the modern battlefield, but they are still used by many developing countries. Most have a warhead attached to a fin-stabilised spigot. For RPG-2 and RPG-7 type launchers, the spigot is 40 mm calibre and has folding or spring-loaded fins. At the rear of the spigot is a paper cartridge enclosing the propellant charge; the cartridge also incorporates a percussion cap. The 73 mm Russian OG-15 is propelled using a rimmed steel 'stub' cartridge case.

Warheads tend to be HEAT or fragmentation, the type normally being obvious from the shape. The Russian OG-7 has a parallel-sided fragmentation warhead of 40 mm diameter that fits right into the launch tube. HEAT warheads such as the PG-2 are larger in diameter, have a characteristic conical ballistic nose and protrude from the launcher. OG-15 has the appearance of a HEAT warhead, but is actually fragmentation.

Operational details

Typical operation

The Russian OG-7 is a typical projected fragmentation grenade and works as follows. On firing, the flash from the percussion cap ignites a small Black Powder charge in the tail section spindle; this ignites the propellant strips surrounding the spindle, firing the grenade out of the launcher and lighting the tracer. The propellant gases pass over inclined surfaces at the rear of the spigot to impart a slow clockwise spin during flight. Once it has exited the launcher, the folding fins open and the grenade follows a ballistic trajectory to its target, where it is initiated by an O-4M impact nose fuze. The fuze detonates the cylindrical HE charge, shattering the steel body to create fragmentation.

The Russian PG-2 is projected in a similar manner, but has a basic HEAT warhead with a steel shaped charge liner. The spring-steel fins are folded around the spigot and deploy as the grenade leaves the launcher. Unlike the later PG-7 (which uses a piezo fuze), PG-2 is initiated by a mechanical impact inertia fuze at the base of the warhead; the sheet-steel nose cone merely enhances aerodynamics and provides adequate stand-off to allow the HEAT warhead to function efficiently.

EOD considerations

- It is important to establish that no rocket motor is present
- In most cases, the warhead shape indicates the role
- Fuzes are often badly damaged during impact and may be in a highly sensitive condition
- Inertia impact fuzes may be sensitive to sudden movement or shock
- Unburned propellant cartridges must be protected from sources of ignition
- Shaped charge precautions should be observed for HEAT warheads.

Typical specifications

Example	Russian PG-2	Russian OG-7	Russian OG-15	Yugoslav M57
Warhead:	HEAT	HE frag (210 g HE)	HE frag (753 g HE)	HEAT
Calibre:	40 mm	40 mm	73 mm	44 mm
Diameter (max):	80 mm	40 mm	73 mm	90 mm
Length:	502 mm	575 mm	825 mm	584 mm
Weight:	1.84 kg	1.76 kg	4.57 kg	2.4 kg

Notes

Projected grenades are easily confused with rocket-propelled grenades (see separate entry). See *RPG ammunition designations* for images and details of other projected grenades.

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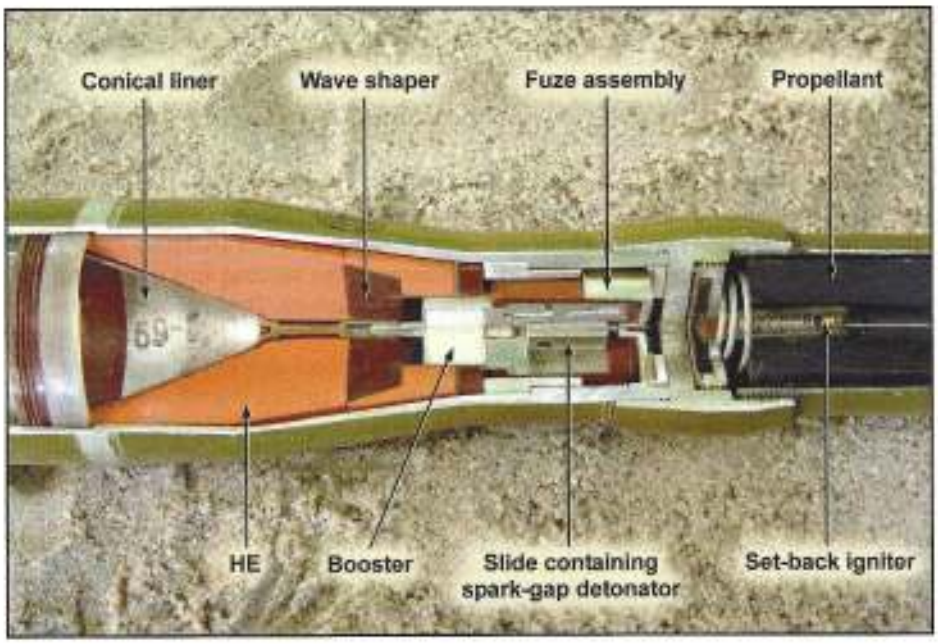
RPG-7 rockets. From the top: North Korean F-7, Russian PG-7M, Chinese Type 69 bounding airburst. Despite its outward appearance, the F-7 has an HE fragmentation warhead, not HEAT (Colin King) 0074246

The HEAT rocket for the 82 mm variant of the Yugoslav M79 (Colin King) 0074245



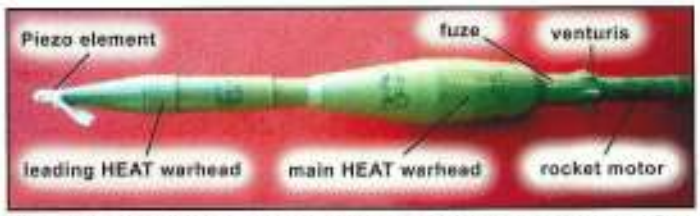
Cutaway of a PG-9 warhead (Colin King) 1375798

The Chinese Type 69-1 is a direct copy of the Russian PG-7 (Colin King) 0532022

PG-18 rocket (below), and cutaway in its launcher (above) (Colin King) 1330365

A Bulgarian PG-9 in Iraq (Colin King) 0573815

The Iranian Nader is compatible with RPG-7 (Colin King) 1375797



Bulgarian PG-7VLT. The tandem HEAT warhead is immediately obvious from the shape (Colin King) 1121139

ROCKET-PROPELLED GRENADES

Description

Rocket-Propelled Grenades (RPGs) can be divided into two categories: those that incorporate a sustainer rocket motor and those that do not. This entry deals with the former; *Projected grenades*, which are not strictly classified as rockets, are covered in a separate entry.

The Russian RPG-7 and its copies are among the most common infantry weapons in the world; RPG ammunition is manufactured by countries including Bulgaria, China and Iran, and may be encountered in virtually any region. Rockets for RPG-7 type weapons often have warheads which far exceed the calibre of the 40 mm launcher, so that the rocket protrudes from the front of the launcher. More modern versions (such as RPG 18, 22, 26 and 27) tend to be in the format of a Lightweight Anti-armour Weapon (LAW), such as the US 66 mm M72, with telescopic disposable launchers. Some of the larger 'Bazooka' type weapons are also still in use, such as the Yugoslav 90 mm M79, and some RPGs (such as PG-9 and PG-15) are fired by guns. Generally, the layout of shoulder-launched rockets is conventional, with the warhead mounted ahead of the motor and a nose-mounted or Point-Initiating Base-Detonating (PIBD) fuze. Most RPGs have HEAT warheads, and the use of tandem warheads (with a small precursor HEAT charge) is increasingly common; in many cases, these are immediately obvious from the external shape. A number of other warheads exist, including bounding fragmentation and fuel-air (thermobaric) types; these are generally rounded, bulbous and far larger than conventional HEAT warheads.

Operational details

Typical operation

PG-7M is typical of RPG ammunition. On firing, the flash from the percussion cap ignites a small Black Powder charge in the tail section spindle; this ignites the propellant strips surrounding the spindle, kicking the rocket out of the launcher and lighting the tracer. The acceleration is used to initiate the flight motor delay, which ignites the rocket motor after approximately 25 m. The fuze consists of two separate assemblies; a nose-mounted piezo element, and the initiation train, which is located at the base of the HEAT warhead. On launch, the fuze arming sequence commences; the acceleration frees a mechanical detente and the inertia striker pyrotechnic train is lit, burning away a locking pellet to free a shutter. As the shutter moves across, the electrical short circuit on the spark gap detonator is removed while the pyrotechnic self-destruct delay ignites. Once the spark gap detonator is in line, it is connected to the nose-mounted piezo element via the two insulated skins of the nose cone. When the rocket strikes a hard target, the piezo element is crushed, passing an electric pulse into the spark-gap detonator and detonating the HEAT warhead. If the piezo fuze is not struck, the self-destruct delay burns out after approximately 9 seconds and sets off the self-destruct detonator. If the nose cone is dented so that the two skins are in contact, the resultant short circuit will cause the piezo fuzing to fail.

EOD considerations

- Where possible, the warhead type should be identified before EOD action
- The location of explosive components should be verified before demolition
- It is important to establish whether rockets are fired or unfired
- Demolition procedures must destroy venturis to prevent unfired rockets from being launched
- Venturis on PG-7 type ammunition are located at the front of the rocket motor
- Fuzes are often badly damaged during impact and may be rendered highly sensitive
- Unburned propellant cartridges must be protected from sources of ignition
- Shaped charge precautions should be observed for HEAT warheads.

Typical specifications

Example	Chinese Type 69	Russian PG-7M	Russian PG-9	Yugoslav M79
Type:	Bounding frag	HEAT	HEAT	HEAT
Calibre:	40 mm	40 mm	73 mm	90 mm
Diameter (max):	75 mm	70 mm	73 mm	90 mm
Length:	825 mm	920 mm	920 mm	672 mm
Weight:	2.8 kg	1.98 kg	4.39 kg	3.5 kg
HE weight:	n/k	300 g	332 g	400 g (approx)

Notes

Where unfired rockets are to be destroyed, charges should be placed to simultaneously crush the venturi and shaped charge cone while initiating both HE and propellant. See also *Projected grenades* and *RPG ammunition designators.*

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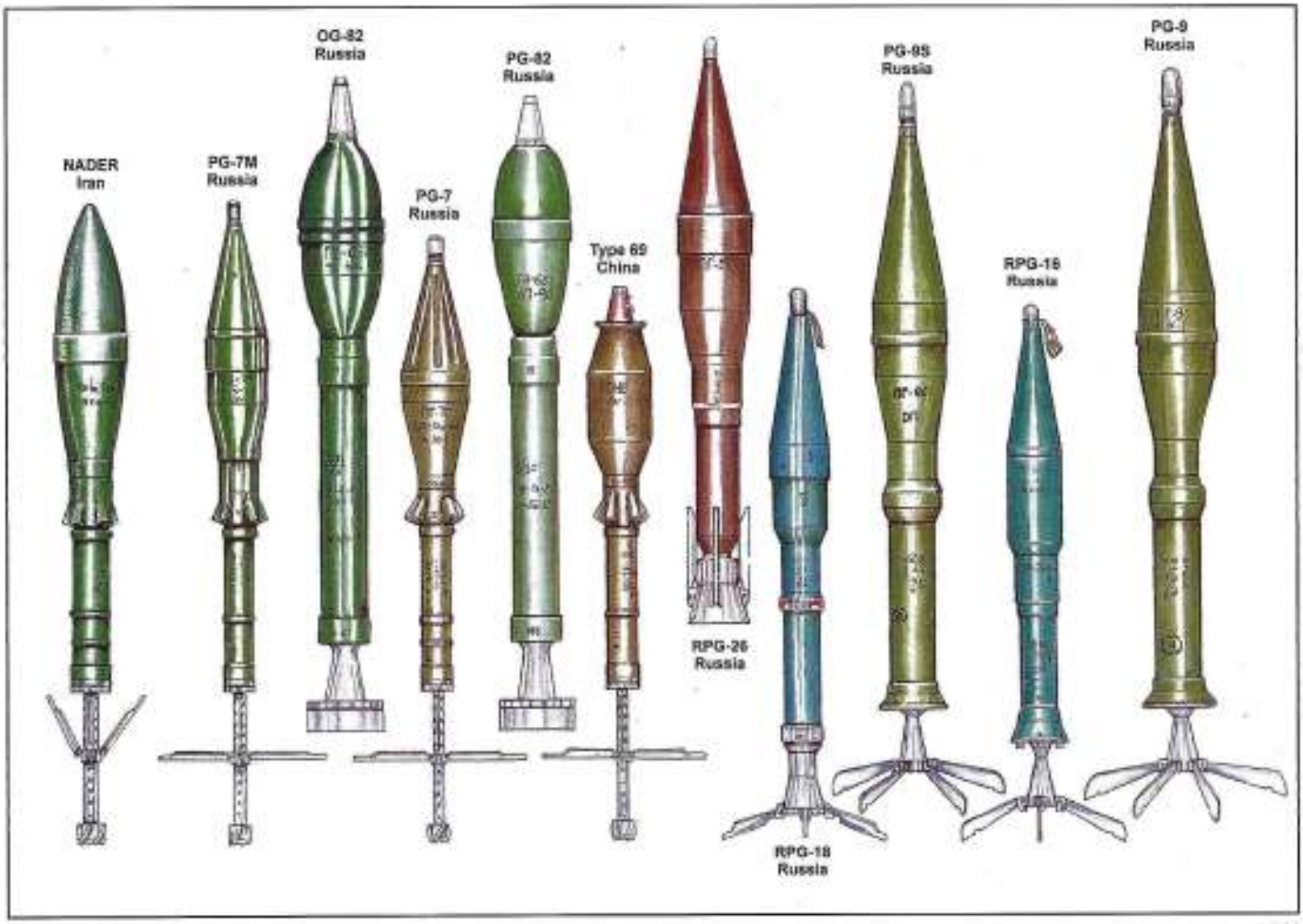
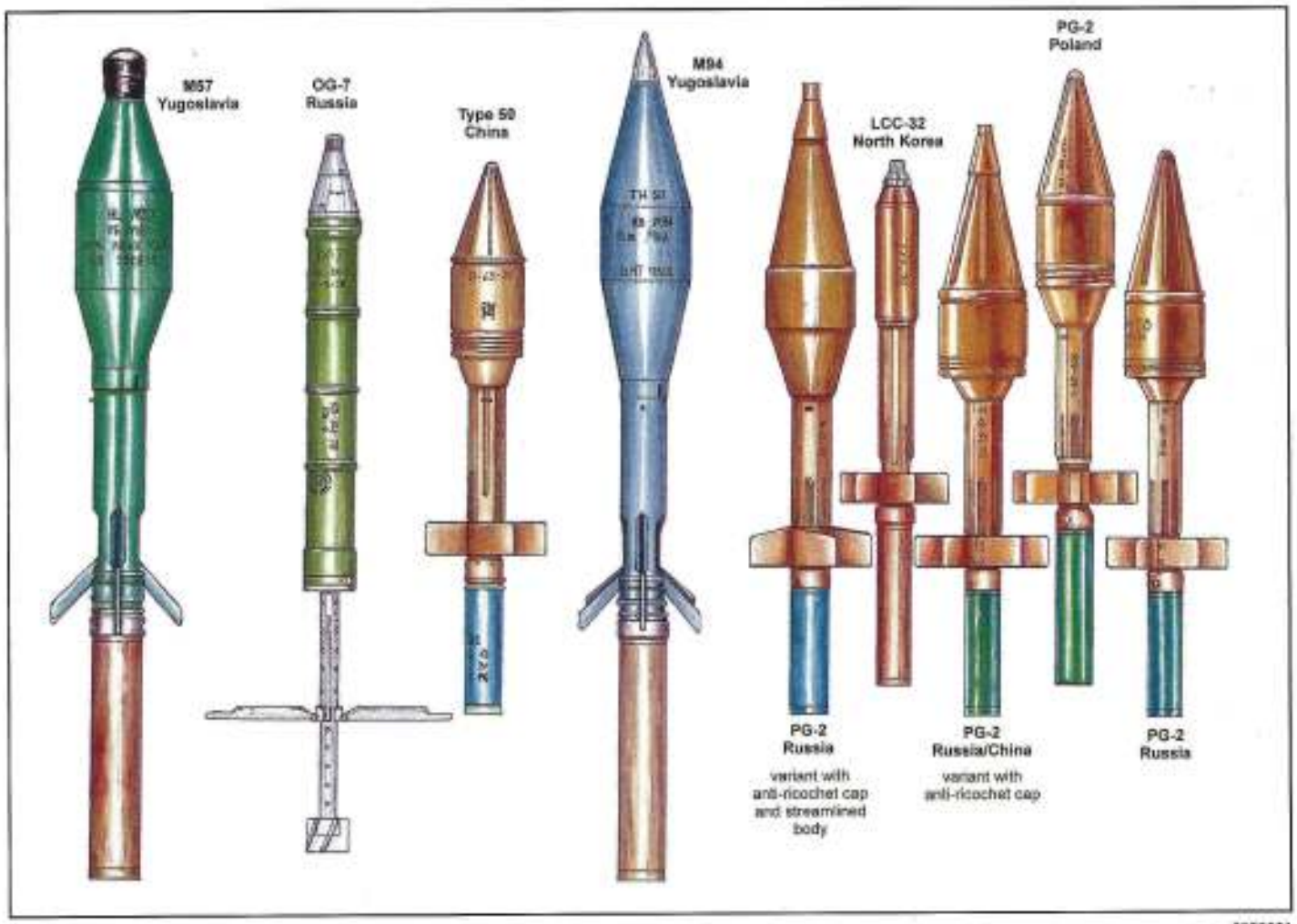


Rocket-propelled grenades (Bob Gravett)

0532020



Projected grenades (Bob Gravett)

0532021

RPG AMMUNITION DESIGNATORS

Description

This entry provides additional detail on shoulder-launched RPGs, including ammunition manufactured for the older RPG systems (RPG-2 and RPG-7) and their Chinese equivalents, the Type 56 (RPG-2) and Type 69 (RPG-7). Other countries with compatible launchers and ammunition include many former Warsaw Pact members, Egypt (SAKR PG-7), Iran (RPG-7), Iraq (Al-Nassira), Pakistan (RPG-7) and Vietnam. Many other countries, including Finland, Poland and the former Yugoslavia, produced weapons closely modelled on the RPG-7.

Rocket	Max diameter	Description	Notes
Borkan	82 mm	Egyptian 2.25 kg grenade with incendiary warhead	Phosphorus with burster charge
F-7	75 mm	Vietnamese HE fragmentation rocket	
GTB-7G, S, S1	various	A Bulgarian range of thermobaric (FAE) warheads similar to the Russian TBG-7	Large bulbous warheads
KO-7	n/k	HEAT warhead with fragmentation collar	Complete round is KO-7V
M57	90 mm	Yugoslav HEAT rocket	For RB M57 and M80 launchers
M79	90 mm	Yugoslav HEAT rocket	For RB M57 and M80 launchers
M80	90 mm	Yugoslav HEAT rocket; M57 with upgraded warhead	For RB M57 and M80 launchers
M99	90 mm	Serbian thermobaric rocket	For RB M57 and M80 launchers
NADER ('Fath')	100 mm (est)	Iranian HEAT rocket for RPG-7	Rounded warhead; RDX charge
NADER (Tandem)	100 mm (est)	Iranian tandem HEAT rocket for RPG-7	Rounded warhead with nose probe
NAFEZ ('Optimised Fath')	100 mm (est)	Iranian HEAT rocket for RPG-7	Long conical nose; HMX charge
OFG-7V	n/k	Bulgarian HE fragmentation OG-7 variant	Complete round is OFG-7VE
OG-7	45 mm	HE fragmentation round with short tubular body	Complete round is OG-7V
OG-7E	n/k	Bulgarian produced blast warhead	Complete round is OG-7VM3
OG-7G	n/k	Bulgarian OG-7 variant with enlarged warhead	Complete round is OG-7VM3
OG-7M	45 mm	As above, but with larger propellant charge	Complete round is OG-7VM
OG-7M3	n/k	As OG-7M, but with prefragmented sleeve	Complete round is OG-7VM3
PG-2	82 mm	HEAT. Fluted nose cone and parallel-sided body	See diagram and photograph
PG-7	73 mm	HEAT. Russian type identified by the fluted nose cone, but variations are manufactured by many countries	Complete round is PG-7V
PG-76	68 mm	Polish HEAT rocket for RPG-76: superficially similar to PG-7	Warhead contains 320 g RDX/wax
PG-7EI	105 mm	Romanian thermobaric round, 940 mm long weighing 4.5 kg	EI stands for explosive incendiary
PG-7M	70 mm	HEAT. Smooth warhead nose cone; longer parallel sided section	Complete round is PG-7VM
PG-7N	70 mm	As above; an updated version of PG-7M with 340 g charge	Complete round is PG-7VN
PG-7L	93 mm	HEAT. Similar shape to PG-7M, but larger	Complete round is designated PG-7VL
PG-7LT	93 mm	As above, but with a tandem warhead. 1.13 m long	Complete round is PG-7VLT
PG-7VM	70 mm	HEAT. Overall length 969 mm.	Look for double circle factory mark
PG-7VR	105 mm	Large tandem HEAT warhead weighing 4.5 kg	Used in Chechnya from 1995
PG-7M 110	110 mm	Slovakian retrofit HEAT warhead option with standoff probe	Uses a VP-7 piezo fuze
PG-29V	105 mm	Tandem HEAT round for the RPG-29	See RPG-29
PG-30	105 mm	Tandem HEAT round for the RPG-30	10.3 kg warhead
PG-I	70 mm	Incendiary warhead	Manufactured in Romania
PUS-7	n/a	RPG training device that fires 7.62 × 57 ammunition	Resembles a PG-7 rocket
RPG-16	n/k	3 kg rocket with HEAT warhead	Similar to RPG-7, but 53 mm calibre
RPG-18	64 mm	HEAT warhead	Fired from disposable launcher
RPG-22	72.5 mm	HEAT warhead	Fired from disposable launcher
RPG-26	72.5 mm	HEAT warhead	Improved version of RPG-22
RPG-27	105 mm	Tandem HEAT warhead	Fired from disposable launcher
RPG-28	125 mm	Tandem HEAT warhead	Fired from disposable launcher
RPG-29	105 mm	Tandem HEAT warhead	Fired from disposable launcher
RPG-75	68 mm	HEAT warhead (320 g HE)	Czech copy of Russian RPG-18
RShG-1	105 mm	Fuel-air 'thermobaric' warhead	Fired from disposable launcher similar to RPG-27
Saegheh	40 mm	Iranian HE fragmentation round for RPG-7	Iranian version of OG-7
TBG-7	105 mm	Fuel-air 'thermobaric' warhead with blunt nose	Complete round is TBG-7V
Type 50	80 mm	Chinese version of the PG-2 HEAT round	See PG-2
Type 69 HEAT	85 mm	Original Chinese PG-7 equivalent with HEAT warhead	No self-destruct fuze
Type 69 Airburst	75 mm	Chinese bounding fragmentation grenade with a 'kopf ring' behind the fuze and 800 steel ball bearings	Bounds to 2 m, lethal radius 15 m See photograph
Type 69-I	85 mm	Modified Chinese PG-7 equivalent with HEAT warhead	No self-destruct fuze
Type 69-II	94 mm	As above, but larger improved warhead	No self-destruct fuze
Type 69-III	80 mm	Similar to the Type 69-I, but with a revised warhead design	Incorporates a self-destruct fuze
Type 70-I	62 mm	HEAT rocket for Type 70-I launcher	Folding fin rocket fits right into launcher
Type 84	85 mm	Significantly shorter Chinese rocket of more modern design	Single rear venturi
ZG-2R	n/k	Bursting incendiary version of PG-2, filled with Tri-ethyl aluminium for spontaneous ignition	Has red band on ogive

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SG 357 is the runway-cratering munition from the British JP 233 system (Colin King/DEODS) 0546811

BLU-108 is the submunition for the CBU-97 or CBU-105 Sensor Fuzed Weapon, which was used in Iraq (Colin King) 0573817

MUSA and MUSPA are two similar submunitions for the German MW-1 system. MUSPA is an acoustically initiated anti-aircraft mine, while MUSA is simply delay-fuzed (Colin King) 1041212

The Alpha bomblet used in the South African CB-470 cluster bomb. The all-ways acting impact fuze incorporates a 0.65 second delay to allow the bomblet to bounce into the air before detonating the 1.4 kg charge (Colin King) 1041046

Convention on Cluster Munitions (CCM) — Extracts from Article 2: Definitions

For the purposes of the Convention, ***Cluster munition*** means a conventional munition that is designed to disperse or release explosive submunitions, each weighing less than 20 kilograms, and includes those explosive submunitions. It does not mean the following:

- a munition or submunition designed to dispense flares, smoke, pyrotechnics or chaff; or a munition designed exclusively for an air defence role;
- a munition or submunition designed to produce electrical or electronic effects;
- a munition that, in order to avoid indiscriminate area effects and the risks posed by unexploded submunitions, has all of the following characteristics:
- each munition contains fewer than ten explosive submunitions;
- each explosive submunition weighs more than four kilograms;
- each explosive submunition is designed to detect and engage a single target object;
- each explosive submunition is equipped with an electronic self-destruction mechanism;
- each explosive submunition is equipped with an electronic self-deactivating feature.

Explosive submunition means a conventional munition that in order to perform its task is dispersed or released by a cluster munition and is designed to function by detonating an explosive charge prior to, on or after impact.

Self-destruction mechanism means an incorporated automatically-functioning mechanism which is in addition to the primary initiating mechanism of the munition and which secures the destruction of the munition into which it is incorporated.

Self-deactivating means automatically rendering a munition inoperable by means of the irreversible exhaustion of a component, for example a battery, that is essential to the operation of the munition.

Mine means a munition designed to be placed under, on or near the ground or other surface area and to be exploded by the presence, proximity or contact of a person or a vehicle.

Explosive bomblet means a conventional munition, weighing less than 20 kilograms, which is not self-propelled and which, in order to perform its task, is dispersed or released by a dispenser, and is designed to function by detonating an explosive charge prior to, on or after impact.

Dispenser means a container that is designed to disperse or release explosive bomblets and which is affixed to an aircraft at the time of dispersal or release.

SUBMUNITIONS

GENERAL

Description

The term 'submunition' can be used to describe any item of ordnance carried in, or ejected by, a dispenser. Anything from a scatterable mine to an incendiary flare might be dispensed as a submunition, the enormous diversity making it difficult to strictly define their characteristics and effects. Among HE submunitions, those designed to be victim-actuated are defined as mines, while those that detonate on impact or delay are generally known as 'bomblets'. These range from very small, simple, cheap devices such as the Russian AO-1SCh and first generation Dual-Purpose Improved Conventional Munitions (DPICM) to the large, highly complex and expensive sensor-fuzed munitions. These include the Russian MOTIV-3M, the US SADARM (Sense And Destroy ARMour), BAT (Brilliant Anti-Tank submunition), and the BLU-108 submunition used with the 'Sensor-Fuzed Weapon'. Artillery projectiles incorporating sensor-fuzed weapons include the French/Swedish BONUS and the German SMArt 155, both of which contain just two submunitions. Pyrotechnic or inert fillings found in submunitions are similar to those in carrier projectiles and include smoke, illuminants and chaff.

The Convention on Cluster Munitions (CCM) includes a definition of a cluster munition, in which certain characteristics of submunitions are also defined. An extract from the CCM is reproduced in this entry. From this, it is clear that the vast majority of bomblets are banned under this legislation, but that certain sensor-fuzed munitions, such as BONUS and SMart, are permitted.

A wide variety of dispensers are used, including missiles, rockets, projectiles and mortars. Land service ammunition with submunition warheads are normally called 'cargo rounds' or 'carriers', while bombs containing submunitions are generally known as 'cluster bombs'. Some air-delivered submunitions are dispensed from canisters that remain attached to the aircraft; examples include the British JP-233, the German MW-1 and the Russian KMG-U. See the separate submunition entries for further details of HE bomblets currently in use.

Operational details

Typical operation

Once the dispenser has been fired, launched or dropped, opening is normally determined by a time delay or proximity fuze. The submunitions are usually dispensed in one of three ways: base ejection, nose ejection or case rupture. Base ejection is most common in projectiles, but is also used in other carriers and some cluster bombs. In both nose ejection and base ejection, the fuze usually initiates a small propellant charge, which opens the carrier and pushes the submunitions out. Case rupture, used in some cluster bombs, rockets and missile warheads, may involve the use of small linear cutting charges to split the casing, and may also use a propellant charge to eject the submunitions. After ejection, most (but not all) submunitions incorporate a separate arming mechanism (such as wind-driven vanes) which functions as the bomblet falls. The majority use some form of stabilisation (normally fins, a streamer or a chute) to bring them into a nose-down attitude, but some are designed to spin in the air stream and use this movement for arming. Since submunitions disperse after ejection, the density of the impact footprint is dependent on the speed and altitude at which the dispenser opens. Most bomblets are designed to detonate on impact, but some (such as scatterable mines) are victim-operated or incorporate delays.

EOD considerations

- Unexploded submunitions incorporating piezoelectric, stab-sensitive or all-ways acting fuzes can be particularly sensitive
- Some types of submunition, such as DPICM, are subject to high failure rates and may therefore be encountered in large quantities
- Large numbers of unexploded bomblets at a contaminated site can substantially complicate an otherwise straightforward clearance operation
- Unexploded submunitions are often found above ground, in vegetation or on man made structures
- Submunition dispensers often incorporate hazardous components, such as ejection charges and linear cutting charges
- The presence of submunitions is often indicated by distinctive impact marks, empty containers and packaging
- The presence of an unexploded submunition often indicates that others are nearby.

Typical specifications

Type	Chute-stabilised	DPICM	Fin-stabilised	Spin-armed
Example:	US BLU-97	US M77	Russian PTAB-2.5M	US M32 'Grenade'
Diameter:	64 mm	38 mm	90 mm	48 mm
Length:	170 mm (closed)	81 mm	395 mm	n/a
Weight:	1.54 kg	213 g	2.5 kg	204 g
Explosive weight:	287 g	33 g	450 g	42 g
Explosive type:	RDX/TNT	RDX/TNT	RDX/TNT	RDX/TNT

Notes

Submunition failure rates are dependent on a number of factors, including design, length and condition of storage, drop height, vegetation, and ground conditions at the impact area. The rigorous design and manufacture of newer sensor-fuzed munitions make them less likely to malfunction than older mechanically fuzed types. The various categories of submunition are detailed in separate entries; see also the National production tables in the *Data summary* section, and entries for *Cluster bombs*, *Russian submunitions*, and *Submunition strike signatures*.

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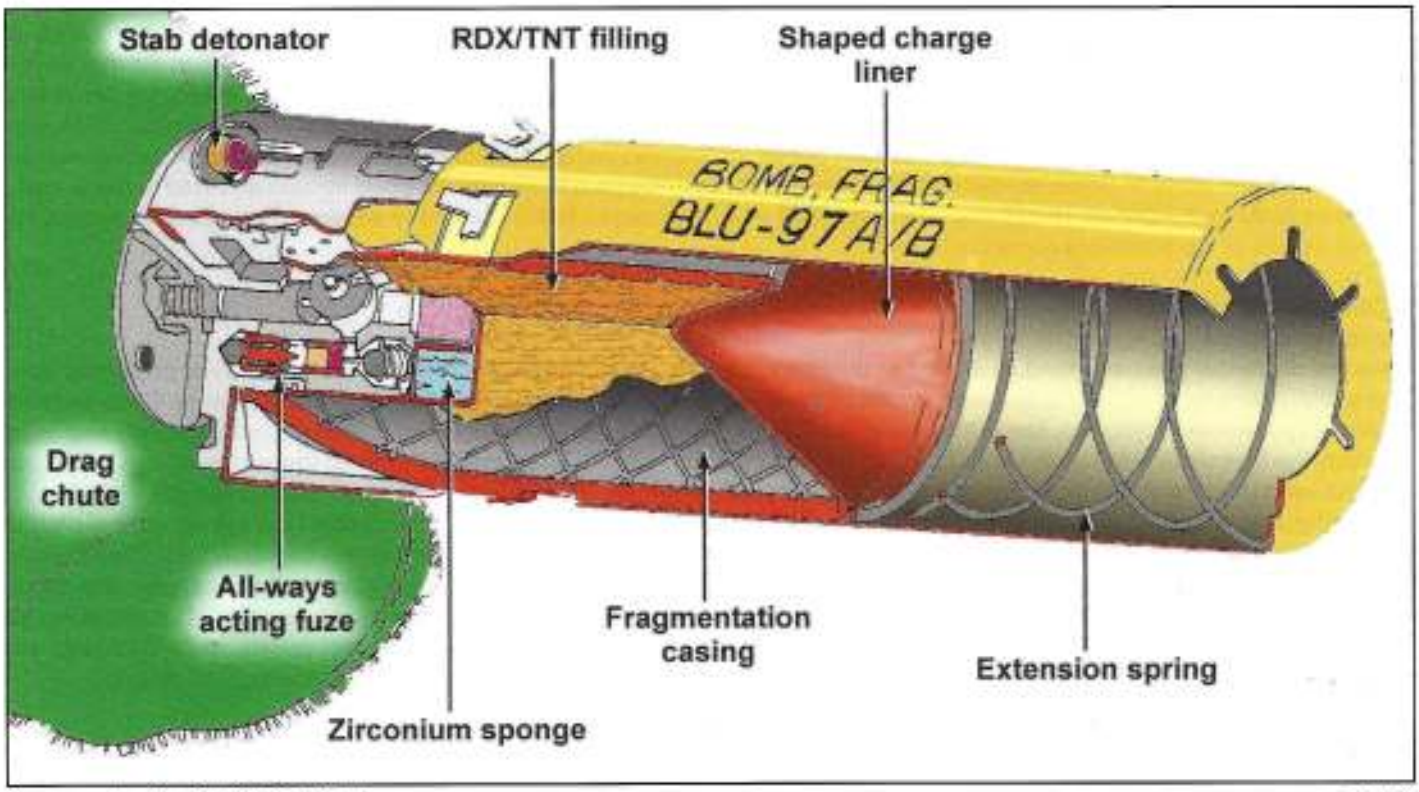
French Belouga submunitions. From the left: 'EG' fragmentation; 'AC' anti-tank; 'IZ' delay-fuzed interdiction 0504470



Components of the BLU-97 (Colin King) 1375865

IBL-755, missing its parachute (Colin King) 1310631

Unexploded BLU-97s in Kosovo. The bomblet to the top left is in the extended configuration (Colin King) 0074225

The US M73 'Hydra', which incorporates an all-ways acting impact fuze (Colin King) 1121134

CHUTE-STABILISED, ANTI-ARMOUR

Description

Some of the more modern submunitions use small parachutes or other forms of flexible airbrakes in preference to rigid fins. Modern US chutes, which inflate in the airstream, are sometimes called 'Attached Inflatable Decelerators' (AIDs), 'Ram Air Decelerators' (RADs) or 'Ballutes'. Other than the method of stabilisation, the characteristics of munitions within this category tend to be similar to those of fin-stabilised anti-armour bomblets (see separate entry). For example, the British Improved BL-755 is basically a chute-stabilised version of the original, with a slightly enhanced warhead. However, since chute stabilisation tends to be used for newer submunitions, some do incorporate more complex components. The US BLU-97 is a 'combined effects' bomblet, incorporating a shaped charge in the front of a heavy steel fragmenting body, which also contains a zirconium sponge to create an incendiary effect. Most bomblets of this type have a single-impact fuzing system, many using piezoelectric initiators. The BLU-97 is unusual in having a stab-sensitive primary fuze and a secondary semi-all-ways-acting impact fuze, both of which are prone to failure. The French BLG 66 'Belouga' has three optional submunitions, the HEAT 'AC grenade', the fragmentation 'EG grenade' and a delay-fuzed fragmentation variant known as the 'IZ interdiction grenade'. The AC has a black body while the EG is green; the IZ grenade is identifiable by its silver and gold coloured fuze, with black cap.

Operational details

Typical operation

Shortly after deployment from the carrier, a drag chute or small inflatable 'airbrake' is ejected from the rear of the bomblet. In the M73 'Hydra' submunition, drag on the chute arms the M230 all-ways acting fuze, which then functions on impact (regardless of impact angle) to initiate the dual-purpose (HEAT/fragmentation) warhead. IBL-755 relies on wind-driven vanes for the fuze arming delay, and is then initiated on impact by a piezoelectric fuze. In the case of the BLU-97, drag on the chute allows the telescopic body to extend and arms the fuzing system. The firing mechanism uses a thin steel rod, which strikes a stab-sensitive detonator at the rear of the casing to energise a piezoelectric element. Two secondary fuzing variants exist (BLU-97/B and BLU-97A/B) to initiate the bomblet if it fails to land on its nose. Both of these use all-ways acting mechanisms which incorporate a ball bearing housed in a chamber with tapered ends. Sideways movement of the ball bearing acts on the sloping surface to push a pin into a stab-sensitive composition. If these mechanisms do not function correctly during impact, they can act like anti-handling devices when the submunition is subjected to further sudden movement. Like their fin-stabilised variants, most chute-stabilised submunitions produce an anti-personnel/anti-matériel effect as the body is shattered, and many are scored to produce consistent fragmentation. The Belouga AG and AC grenades have impact fuzes; the IZ grenade can be programmed for delays between 13 minutes and 7 hours 10 minutes.

EOD considerations

- This type of submunition may fail to arm if the release altitude or airspeed is too low
- Bomblets are prone to failure if the angle of impact is too great, or if their fall is broken by vegetation or soft ground
- Some bomblets, such as the Belouga IZ grenade, may incorporate a delay fuze
- Partially impacted fuzes may be fully armed and highly sensitive
- When a BLU-97 bomblet fails to detonate on impact, the secondary fuzing system can act like an anti-handling device
- The presence of an unexploded submunition often indicates that others are nearby
- Impact marks, debris, packaging and so on should indicate the presence of a submunition strike.

Specifications

Example	British Improved BL-755	French 'Belouga' GR-66-IZ grenade	US BLU-97
Type:	HEAT/frag	HE frag; variable delay fuzing	HEAT/frag/incendiary
Diameter:	68 mm	66 mm	64 mm
Length (closed):	149 mm	153 mm	170 mm
Length (extended, with chute):	630 mm	n/k	280 mm
Weight:	900 g	1.3 kg	1.54 kg
Explosive weight:	230 g	386 g	287 g
Explosive type:	RDX/TNT	RDX/TNT	RDX/TNT

Notes

All of the bomblets mentioned here are banned under the Convention on Cluster Munitions (CCM); see *Submunitions, General*. The fragmentation from BLU-97 is far larger than that from most other NATO submunitions and can penetrate more than 6 mm of steel at 11 m stand-off. Unexploded BLU-97 submunitions have been responsible for a large number of casualties in Afghanistan, the Gulf and Kosovo. See also the National production tables in the *Data summary* section, and separate entries for *Cluster bombs* and *Submunition strike signatures*.

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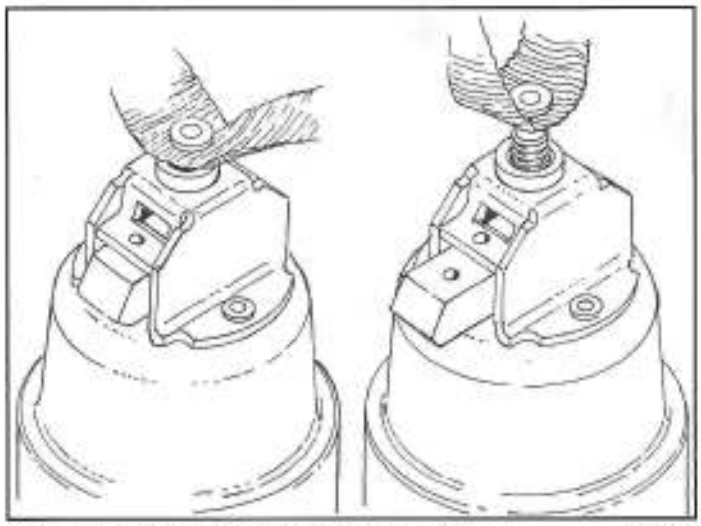
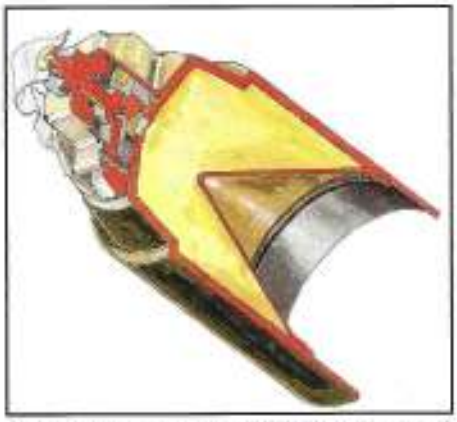
The Yugoslav KB-1 (left) and US M42 DPICM (Colin King) 0074213



The US M42 fuze: unarmed (left) and armed (right) 0074127



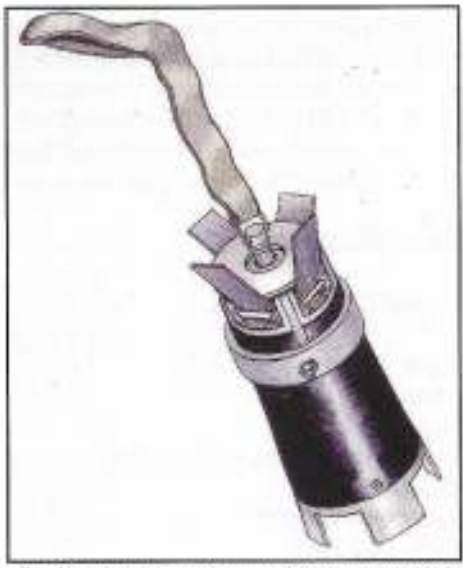
Section through a typical DPICM (Lyn Haywood) 0074126

An unexploded M77 DPICM in Iraq. The protruding detonator slide shows that the bomblet is armed (Colin King) 0573821

The inside of the M77 casing is 'coined' to produce consistent fragmentation (Colin King) 1329690

The Chinese Type 81 was found in Iraq (George Zahaczewsky) 1121133

The Chinese MZD-2 bomblet was used in Lebanon (Colin King) 1310629



The Brazilian Astros II submunition (Lyn Haywood) 0546814

DPICM WITHOUT SELF-DESTRUCT

Description

Dual-Purpose Improved Conventional Munitions (DPICM) are dispensed in large numbers, normally using projectiles or artillery rockets, although other carriers, such as mortar bombs, may also be used. The tubular body is usually made from steel, with the open end housing a copper-shaped charge liner. The liner is recessed into the casing to provide the stand-off needed to allow the jet of the shaped charge to form, making one end of the bomblet hollow. This also allows the submunitions to be stacked on top of one another in their dispenser, the fuze located in the hollow of the one above. In some examples, the side wall of the casing is internally notched or 'coined', while the Yugoslav KB-1 and Chinese MZD-2 are fitted with a matrix of small steel balls set in plastic. The narrow end of the body is generally domed or stepped and fitted with a simple impact fuze. The fuze incorporates a small striker threaded into a collar and attached to a loop of fabric ribbon; until deployment, this is folded over the top of the fuze and may be secured with a retaining clip. The striker retains a spring-loaded transverse slide fitted with a small stab-sensitive detonator. Most, including the Yugoslav KB-2, the US M46 and M77, are very similar in appearance and operation, being based on the design of the US M42. More recent designs, such as the French F1 and Israeli 'Bantam' (designated M85 by the UK and DM 1385 by Germany) incorporate a Self-Destruct (SD) feature that makes the fuze larger and more complex; these are covered in a separate entry *DPICM with self-destruct.*

Operational details

Typical operation

Once released from the carrier, the ejected bomblet retains the spin of the carrier projectile and the ribbon unfurls and brings the bomblet into a nose-down attitude. Some variants have other features, such as small fins or chutes, to stabilise flight or decelerate the submunition. In most cases, drag on the chute or ribbon is used to arm the simple impact fuze. The ribbon vibrates in the air stream and causes drag to oppose the spin of the bomblet; this unscrews the threaded striker and releases the detonator slide. Once free, the slide is moved across by its spring, or by centrifugal force, bringing the detonator into line with the striker. On impact, inertia carries the striker forward into the stab-sensitive detonator, beneath which are a small booster pellet and the main charge. The body is shattered to create anti-personnel fragmentation and the shaped charge fired downwards into the target. In the case of the Yugoslav KB-1 and Chinese MZD-2, the ball-bearings surrounding the body are also scattered to enhance the anti-personnel effect. If the ribbon is caught on a structure, or by vegetation, the striker is held away from the detonator and the bomblet will not function; this is particularly dangerous if the submunition is suspended above the ground, where a further fall might result in detonation.

EOD considerations

- DPICM are generally subject to high failure rates
- The presence of DPICM is often indicated by torn ribbons and packing pieces from the carrier
- The discovery of an unexploded DPICM generally indicates that others are nearby
- Normally found on the surface, but may become buried or entangled above ground in vegetation and structures
- The fuze may fail to arm if the drop height is insufficient, or if the striker and slide are damaged or obstructed
- The bomblet may arm, but fail to detonate if it impacts at the wrong angle, among vegetation, or on soft ground
- The position of the slide normally indicates whether or not a bomblet is armed
- Movement, particularly lifting by the ribbon, may cause an unarmed bomblet to arm
- If armed, the munition is likely to be highly sensitive to pressure or impact on the fuze.

Typical specifications

Example	US M42	US M77	Yugoslav KB-1
Diameter:	38 mm	38 mm	40 mm
Length:	81 mm	81 mm	80 mm
Weight:	198 g	213 g	210 g
Explosive weight:	33 g	33 g	30 g
Explosive type:	RDX/TNT	RDX/wax	RDX/TNT
Self destruct:	No	No	No

Notes

All of the bomblets mentioned here are banned under the Convention on Cluster Munitions (CCM); see *Submunitions, General.* Specifications for US DPICM were changed during manufacture and strikers may have either right-hand or left-hand threads; no attempt should be made to rotate the striker or move the detonator slide. See also the National production tables for submunitions in the *Data summary* section, and entries under *Cluster bombs.*

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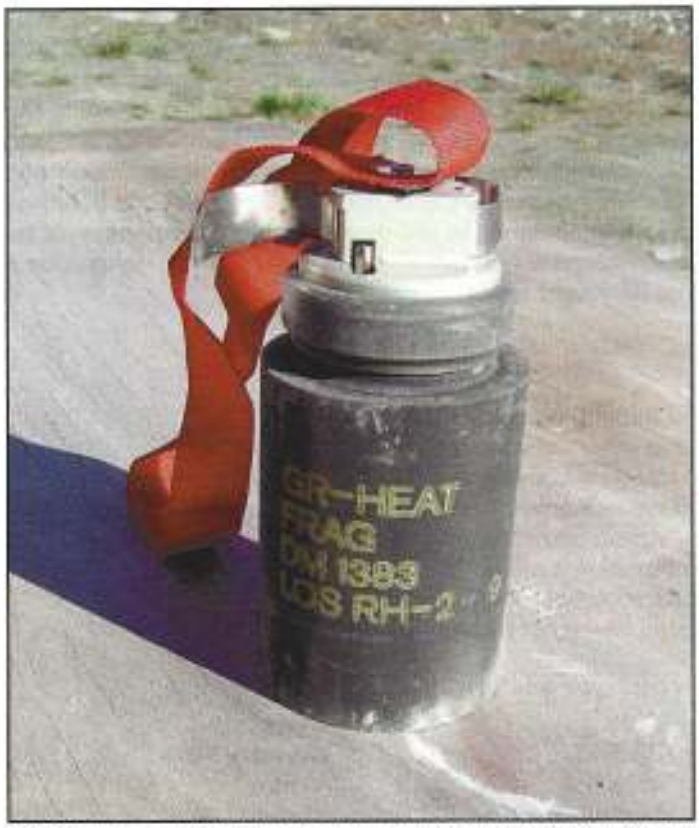
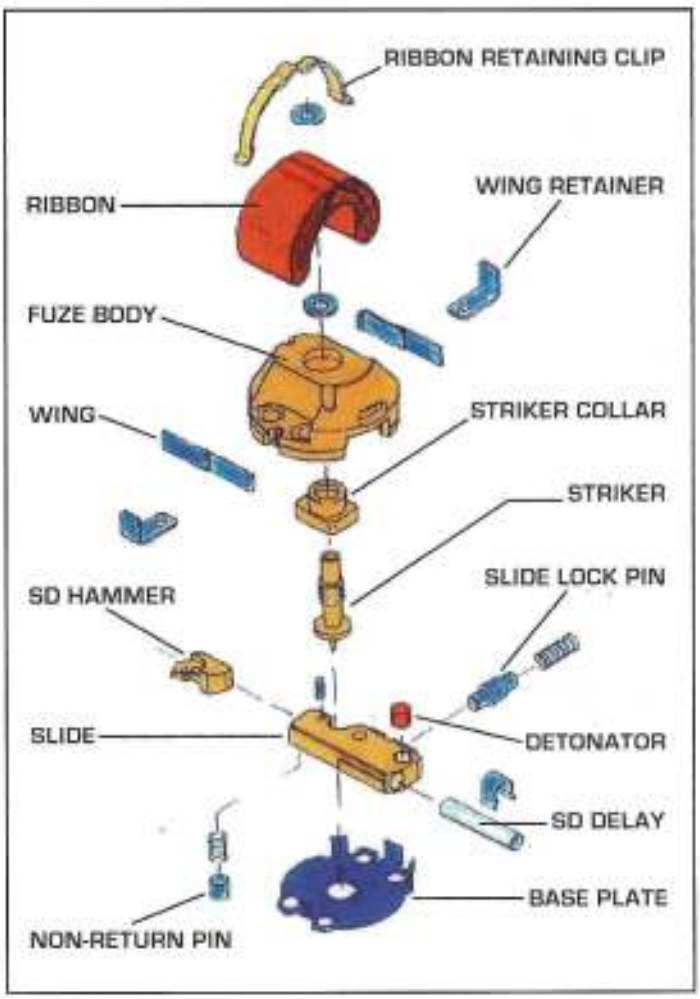
DM1385 in Lebanon, fully armed and with SD hammer fully deployed (see arrow) showing that both the impact and self-destruct fuzing systems have failed. A bomblet in this condition should never be moved (Colin King) 1310685

A DM1385 (M85) 'Bantam' in the unarmed condition (Colin King) 1310632



DM1383 uses an additional safety ribbon wrapped around the fuze to delay arming (Colin King) 1329654



Components of the DM1385 fuze 1310696

The French F1 'Ogre' bomblet incorporates a 17-second self-destruct delay (Colin King) 1041047

The M87 is a shortened version of the M85 'Bantam', for use in mortar bombs (Colin King) 1375868

DPICM WITH SELF-DESTRUCT

Description

This entry deals with Dual Purpose Improved Conventional Munitions (DPICM) that are fitted with a Self-Destruct (SD) feature; non-SD DPICM are covered in a separate entry. By far the most common of the DPICM with SD is the Israeli M85, also known as the 'Bantam', which is designated DM1385 in Germany. Variants of the M85 include the shorter M87 (for use in mortars) and the Hornet 5, which was developed for use in 105 mm projectiles. Another German design, DM1383 is far less common and uses a completely different fuze mechanism. Like other DPICM, SD types are dispensed in large numbers using projectiles or artillery rockets. The tubular body is made from steel, with the open end housing a copper shaped charge liner. In the case of M85, the body has 13 steel fragmentation rings, each with around 50 notches, to create even fragmentation. The shaped charge liner is recessed into the casing to provide the stand-off needed to allow the jet of the shaped charge to form, making one end of the bomblet hollow. This also allows the submunitions to be stacked on top of one another in their dispenser, the fuze located in the hollow of the one above. Superficially, SD DPICM look very similar to non-SD types and are similar sizes. Where they remain unexploded, it may require close examination to establish the type, particularly to distinguish between the SD and non-SD variants of the M85. In contrast to the simple impact fuze mechanisms used with most DPICM, the SD types are generally complex and incorporate a pyrotechnic delay; this begins as the bomblet arms, and is intended to initiate the main charge should the primary fuzing mechanism fail.

Operational details

Typical operation

DM1385 (M85) Once ejected, the bomblet retains the clockwise spin from the carrier projectile, which releases the spring-loaded transverse slide lock pin by centrifugal force. The ribbon unfurls, bringing the bomblet into a nose-down attitude and creating anti-clockwise drag on the striker. This unscrews the striker into its collar, withdrawing it from the slide and also releasing the two wing retaining tabs. The slide moves across, also under centrifugal force, bringing the detonator into line beneath the striker. As the slide moves, a hammer assembly and firing pin at the end rotates to strike a stab receptor in the end of the slide; this initiates the pyrotechnic self-destruct delay. As the slide reaches full extension, a non-return pin on the underside locks it into place. With the wings deployed, the rate of rotation slows; this is because a high spin rate would adversely affect the formation of the HEAT jet. On impact, the striker falls onto the stab-sensitive detonator to initiate the RDX booster pellet and main charge. Should this fail, the pyrotechnic delay should initiate the detonator after 15 seconds. If the slide is fully extended then the fuze is armed; if the slide has not moved, and is aligned at both ends with the faces of the fuze body, then the fuze is basically unarmed, although elements of the arming sequence may have occurred. The slide lock pin can also lock the slide into a safe mid-way position if there is insufficient spin or slide movement.

DM1383 is similar in principle, but uses two slide lock pins, an enclosed spring-loaded detonator slide and a fixed firing pin to initiate the SD delay. An additional ribbon is wrapped around the DM1384 fuze to delay arming.

EOD considerations

- The discovery of an unexploded DPICM frequently indicates that others are nearby
- Normally found on the surface, but may become buried or entangled in vegetation and structures
- Damage during ejection or mid-air collision often results in component malfunction
- The fuze may fail to arm if the drop height or spin are insufficient, or if the striker and slide are damaged or obstructed
- The bomblet may arm but fail to detonate if it impacts at the wrong angle, among vegetation, or on soft ground
- 'Unarmed' bomblets can become fully armed by sustained movement
- After disturbance or EOD action, a 'soak time' should be allowed in case the SD has been initiated
- If armed, the munition is likely to be highly sensitive to pressure or impact on the fuze
- Disturbing unexploded bomblets may initiate the SD delay.

Typical specifications

Example	French F1 'Ogre'	German DM1383	Israeli M85/German DM1385
Diameter:	40 mm	42 mm	42 mm
Length:	90 mm (est)	95 mm	78 mm
Weight:	244 g	290 g	200 g
Explosive weight:	32 g	45 g	45 g
Explosive type:	RDX/wax	RDX/wax	RDX/wax
Self-destruct delay:	17 sec	15 sec	15 sec

Notes

All of the bomblets mentioned here are banned under the Convention on Cluster Munitions (CCM); see *Submunitions, General*. See also the National production tables for submunitions in the *Data summary* section, and entries under *Cluster bombs*. Recent testing and evidence from the conflict in Lebanon indicate that failure rates for the M85 are substantially above the 1–2% claimed by the manufacturers and user nations, while safety features often fail to prevent accidental initiation.

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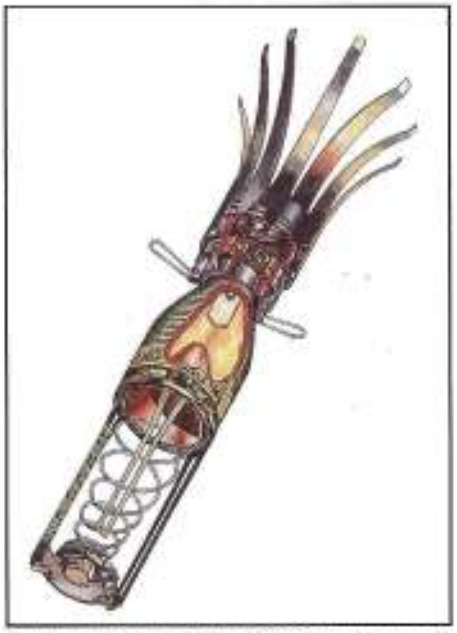
Russian PTAB-2.5KO (Colin King) 0074218

The US Mk 118 'Rockeye' (left) uses a stab detonator with a piezoelectric element; the 'VECF modified' version (right) has a mechanical fuze and explosive relay (Lyn Haywood) 0074731

The British BL-755 (Colin King) 0673823



Cutaway diagram of the BL-755 (Lyn Haywood) 0074130

KB-44 is an anti-armour bomblet used with the German MW-1 dispenser (Colin King) 1121137

The Chilean PM-1 is found in Iraq and Sudan (Colin King) 1121132

FIN-STABILISED, ANTI-ARMOUR

Description

The majority of the older fin-stabilised anti-armour bomblets used fixed fins with a central void to enable the submunitions to be packed tightly nose to tail. The US Mk118 'Rockeye' was one of the first such designs. This bomblet has a cylindrical body incorporating a HEAT warhead with a rear-mounted fuze and fixed plastic fins. Russian designs, such as the PTAB series (see *Russian submunitions*), have larger cylindrical steel bodies and steel fins; older models had fixed fins while the newer PTAB-2.5KO has folding fins. Some designs (such as the British BL-755) telescope, allowing them to be packed together tightly in the dispenser and then deploy into their attack configuration when released. Most fin-stabilised anti-armour bomblets have arming impellers and either piezoelectric or impact fuzes, though many variations exist. The Russian PTAB-2.5M uses an impeller-armed electrical fuze with a 'spit-back' initiator to a detonator at the base of the shaped charge cone. All types optimise the efficiency of the HEAT warhead, by creating some stand-off to allow the formation of the shaped charge jet. This is achieved either by mounting the charge well back in the body or by placing a probe on the front. Configurations vary, and the presence of a HEAT warhead may not be obvious from the external shape.

Operational details

Typical operation

On ejection from the cluster bomb, the bomblet adopts its attack configuration, with folding or telescopic fins deploying to bring the bomblet into a nose-down attitude. The airstream passing over the vanes of the arming impeller causes it to rotate, providing a mechanical arming delay. In some types (such as the Russian PTAB-2.5M), the arming rotor unscrews, and its position may indicate whether or not the fuze is armed. Newer versions of the US Rockeye have a window in the fuze body that shows red or green to indicate whether the submunition is armed. When the bomblet strikes a hard object nose-first, the detonator at the rear of the shaped charge is initiated to produce an anti-armour effect. Most also produce anti-personnel/anti-matériel fragmentation as the body is shattered, and many are scored or notched to enhance the effect. Since all incorporate some form of arming delay, the submunitions will not function if the drop altitude is too low; in this case they will be unarmed and relatively safe. Anti-armour bomblets are also prone to failure when they strike soft ground or if their descent is slowed by vegetation; this may sensitise the armed fuze without causing initiation and can leave them in a very dangerous state. Most of the fin-stabilised anti-armour bomblets currently in service do not incorporate a self-destruct feature.

EOD considerations

- This type of submunition may not arm if the release altitude of the cluster bomb is too low
- Bomblets are prone to failure if the angle of impact is too great, they fall among vegetation or on soft ground
- Their high sectional density means that these submunitions tend to penetrate soft ground and become buried
- Partially impacted fuzes may be in a highly sensitive state, particularly piezoelectric types
- The Chilean PM-1 is similar in appearance to the Rockeye, but incorporates an all-ways acting fuze
- The presence of an unexploded bomblet indicates that others may be nearby
- Impact marks, debris and packaging normally indicate the location of a submunition strike.

Typical specifications

Example	Russian PTAB-2.5KO	US Mk 118 Rockeye	British BL-755
Fin type:	Folding, steel	Fixed, plastic	Fixed, spring steel
Diameter:	59 mm	48 mm	72 mm
Length:	300 mm	316 mm	360 mm
Weight:	2.5 kg	610 g	900 g
Explosive weight:	450 g (est)	183 g	230 g
Explosive type:	RDX/TNT	HMX/TNT	RDX/TNT

Notes

All of the bomblets mentioned here are banned under the Convention on Cluster Munitions (CCM); see *Submunitions, General*. The Rockeye and the BL-755 have suffered high failure rates in areas of soft ground. See also National production tables for submunitions in the *Data summary* section, and separate entries for *Russian submunitions*, *Cluster bombs* and *Submunition strike signatures*.

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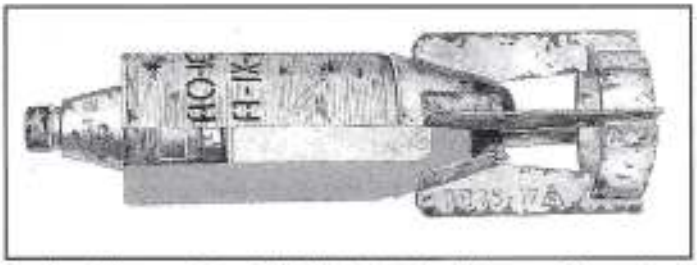
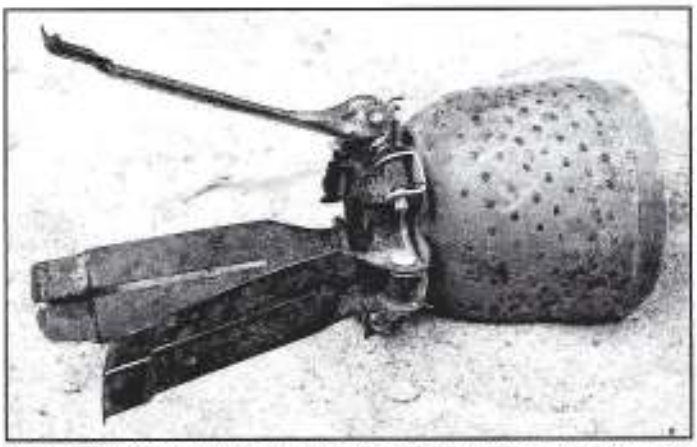
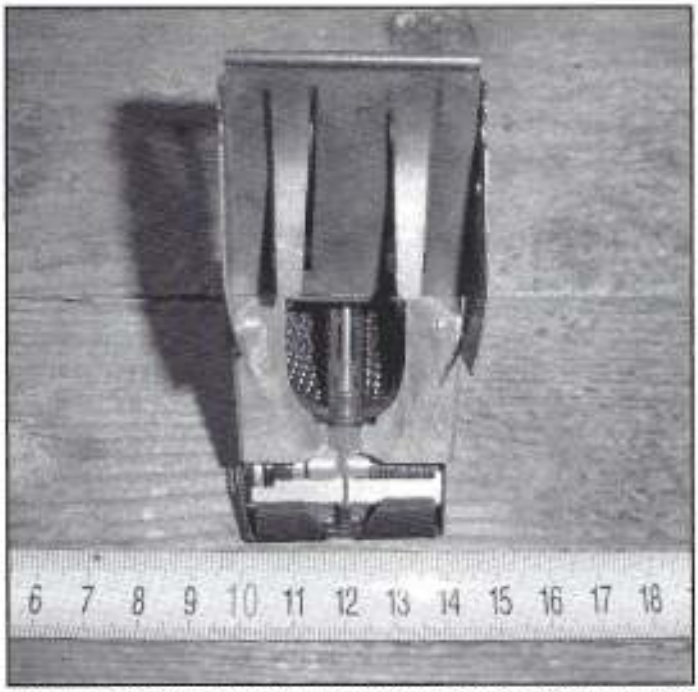
The Russian AO-1SCh fragmentation bomblet (Colin King) 0074215



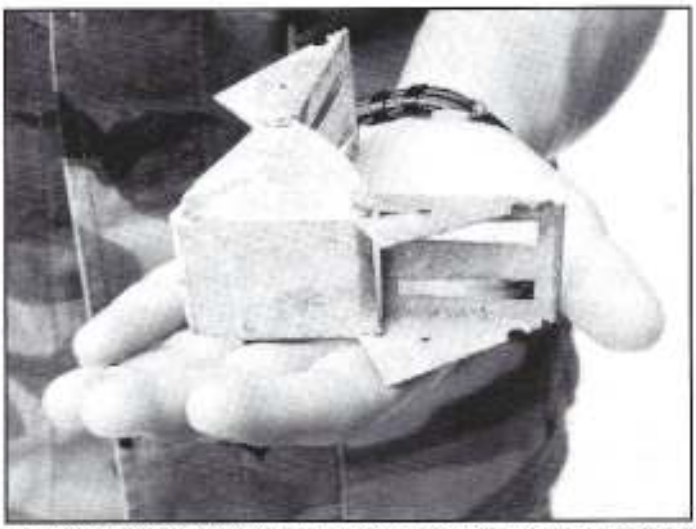
Sectioned diagram of the AO-1SCh, showing the thickness of the steel body (Lyn Haywood) 0074128



The US BLU-3/B. Note the ball-bearings embedded in the aluminium body (Colin King) 0074216



A cutaway M43 shows the spherical fragmentation warhead inside the body (Colin King) 1342176



The arming and initiation mechanism of the US M43 is similar to a DPICM, but it ejects a bounding fragmentation grenade (Colin King) 0573824

The Russian 9N235 was recently used in Georgia. The impact fuze incorporates a 2-min SD back-up (Colin King) 1375953

FIN-STABILISED, FRAGMENTATION

Description

Fin-stabilised fragmentation bomblets are normally dispensed from cluster bombs carried on fixed-wing aircraft. These are mostly older bomblet designs, since more modern submunitions tend to incorporate a dual-purpose (anti-armour and anti-personnel) warhead. Fragmentation bomblets generally have cylindrical cast steel bodies which are relatively thick in proportion to the size of the munition. Exceptions include the casing of the US BLU-3/B, which is made from aluminium with steel balls set into it, and the wedge-shaped US M43, which ejects a spherical fragmentation grenade when it strikes the ground. The Russian 9N210 and 9N235 are externally similar, but the former contains 370 fragments of around 4 g each, while the latter has 96 fragments of 4.5 g and 300 smaller fragments, each weighing only 0.8 g.

Fins fitted to the rear of the bomblet body are normally made from sheet steel or plastic, and may be either fixed or spring-loaded. During transit, spring-loaded fins tend to be folded around the body to make the bomblet compact, allowing more submunitions to be carried within the dispenser. Deployment of the fins may also be used to initiate the arming sequence. Most fin-stabilised fragmentation bomblets use simple impact fuzes, which are normally fitted to, or incorporated within, the nose. Unlike fin-stabilised anti-armour submunitions (see separate entry), many of these older bomblets do not incorporate an arming delay.

Operational details

Typical operation

Once ejected from the dispenser, folding fins (where fitted) open and the bomblets begin to disperse. The fins bring the bomblet into a nose-down attitude, so that the mechanical impact nose fuze will strike the ground directly. In the BLU-3/B and M43, deployment of the fins allows the nose cap and striker to move forward, allowing an arming slide (similar to that of a DPICM) to move into line. The Russian AO-2.5 is armed by vanes rotating in the airstream; these unscrew a cap to release safety blocks from around the striker. The AM-A fuze fitted to the Russian AO-1SCh has no arming delay, it simply uses a pin suspended in front of the detonator and relies on the structure of the fuze body for protection during transit and deployment. Fuzes function on impact, normally by the direct action of a pin being driven into a stab-sensitive detonator assembly. As the main charge detonates, the body is shattered to create a lethal radius of 10 to 20 m. The M43 is exceptional because initiation of the primer fires a small propellant charge to eject a spherical fragmentation grenade (fitted with a short pyrotechnic delay) from the top of the submunition. Fin-stabilised fragmentation bomblets are prone to failure if they hit soft ground or if their descent is slowed by passage through vegetation. Most fin-stabilised fragmentation bomblets do not incorporate a Self-Destruct (SD) feature; exceptions include the 9N210 and 9N235 which have SD times of 1 and 2 minutes, respectively.

EOD considerations

- In some cases, there is no external indication of whether or not a bomblet is armed
- Failed fuzes can be sensitive since the firing pin may be touching, or imbedded in, the stab-sensitive detonator
- Bomblets may become entangled in vegetation or suspended on structures
- Bomblets that fail to detonate on soft ground may end up buried well below the surface
- A bomblet may fail to detonate if it impacts at the wrong angle or if its descent is slowed
- Thick-walled varieties can produce heavy fragments that may be lethal at substantial ranges
- The presence of an unexploded submunition may indicate that others are nearby.

Typical specifications

Example	Russian AO-1SCh	Russian 9N235	US BLU-3/B	US M43
Diameter/width:	49 mm	65 mm	70 mm	41 mm (body)
Length:	156 mm	265 mm	95 mm	54 mm (body)
Weight:	1.2 kg	1.76 kg	785 g	218 g
Explosive weight:	200 g	310 g	165 g	22 g
Explosive type:	TNT	RDX	RDX	RDX

Notes

All of the bomblets mentioned in this entry are banned under the terms of the Convention on Cluster Munitions (CCM); see *Submunitions – General*. See also National production tables for submunitions in the *Data summary* section, and separate entries for *Cluster bombs* and *Russian submunitions*.

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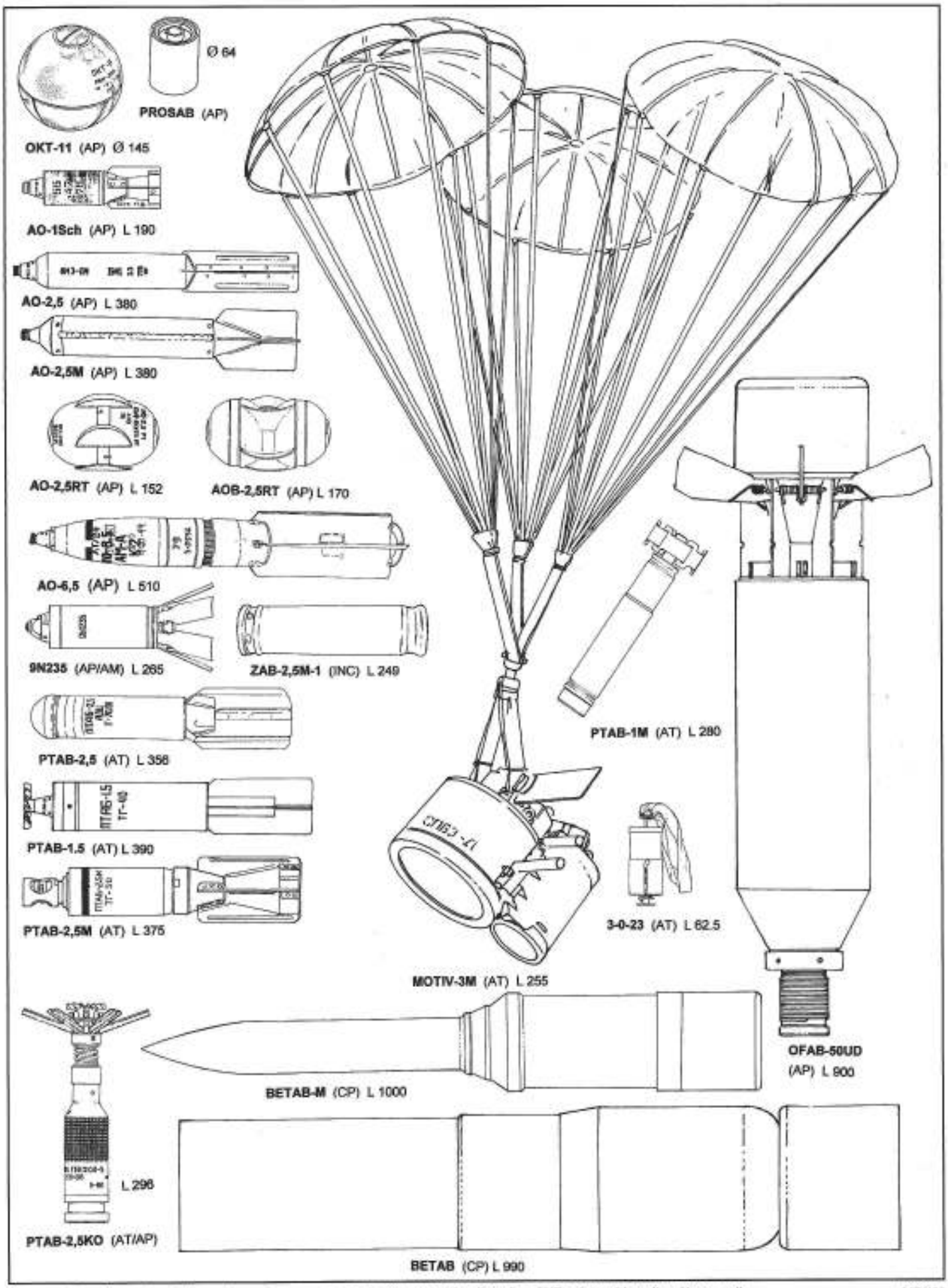
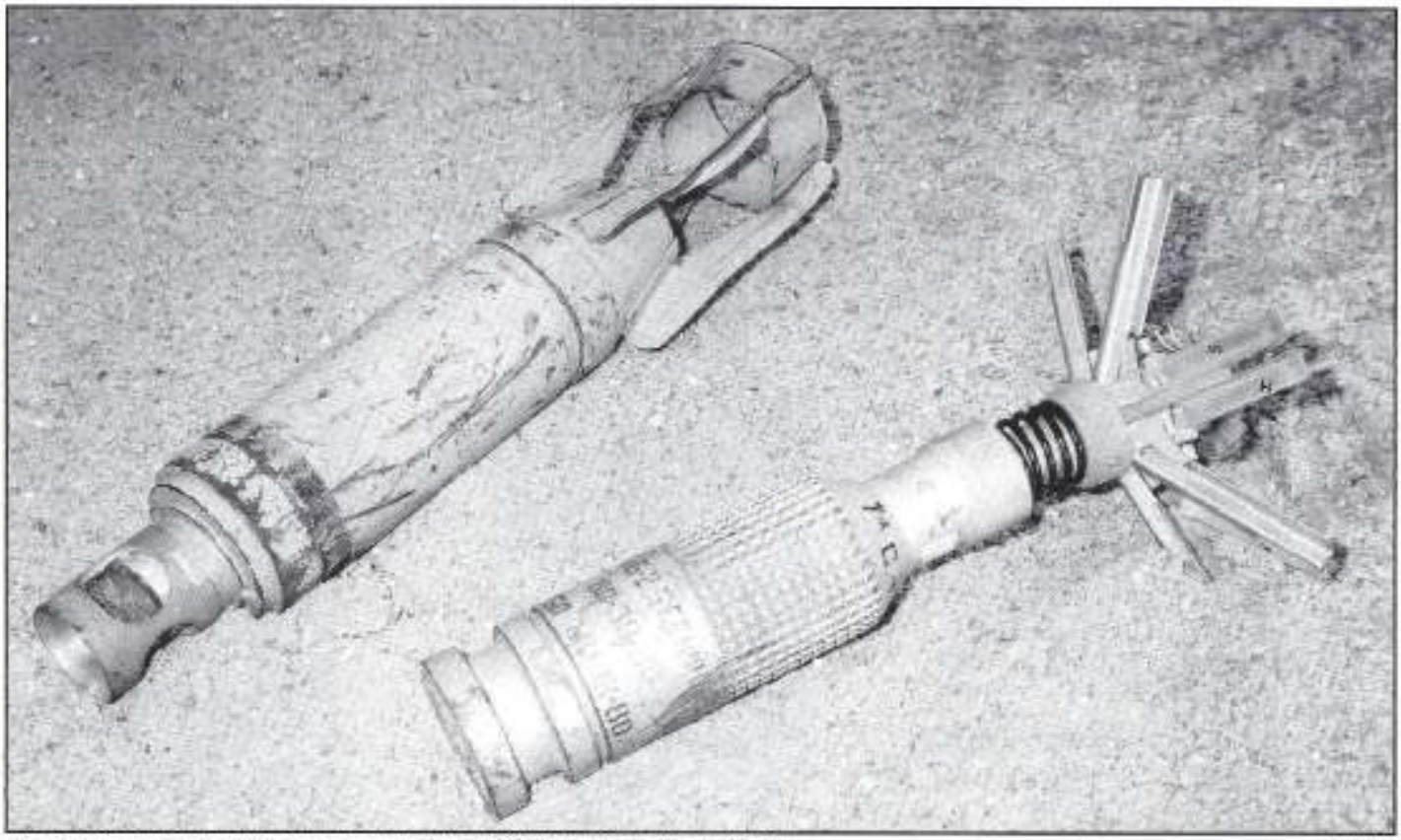
RUSSIAN SUBMUNITIONS

See also other entries in the *Submunitions* section for more detail on individual Russian submunitions.



A range of Russian submunitions, drawn to a common scale, illustrates the diversity of HE submunitions (Lyn Haywood)

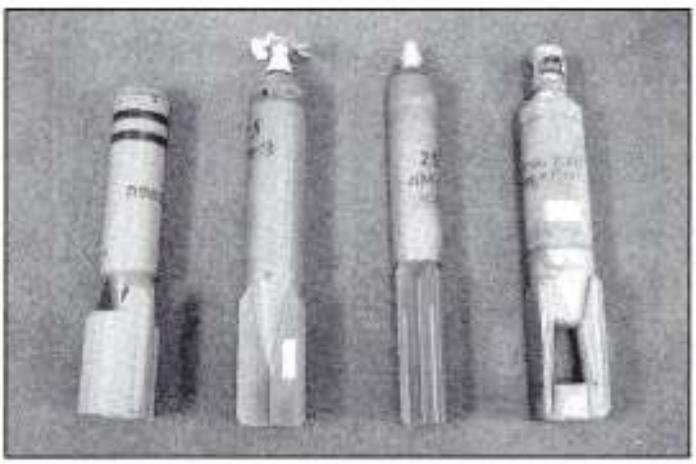
0074136



The obsolescent PTAB-2.5M (top) and newer PTAB-2.5KO (below) (Colin King/DEODS) 0546815

9N210 and 9N235 are anti-personnel/anti-material bomblets dispensed by artillery rockets (Colin King) 0546816

AO-2.5RT is a spin-armed submunition which splits into two fragmentation warheads (Colin King) 0546817



Russian bomblets. From the left: PTAB-2.5, AO-2.5M, AO-2.5, PTAB-2.5M (Colin King) 1121136

AO-10 was an early 10 kg fragmentation bomblet (Colin King) 1121138

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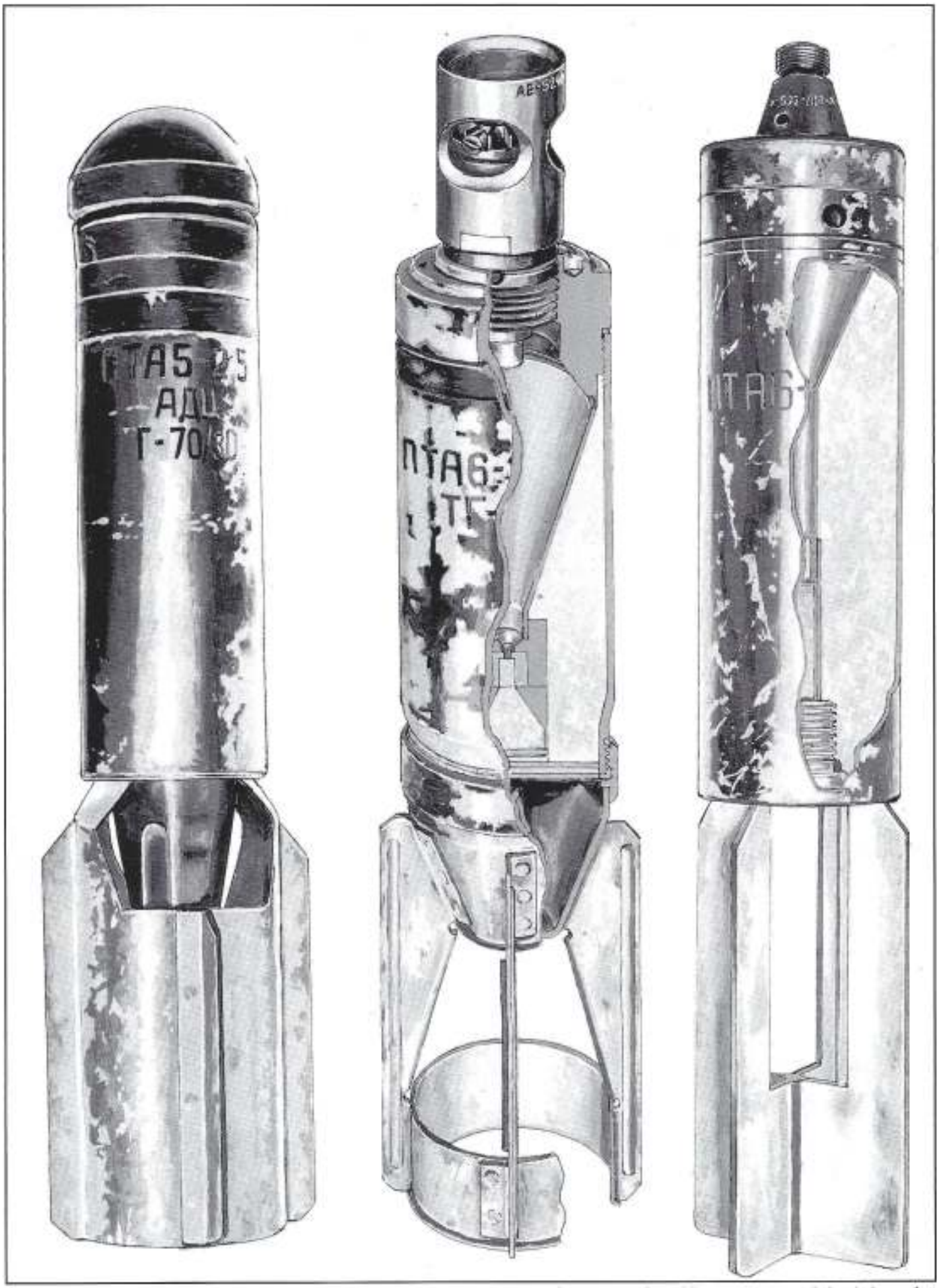
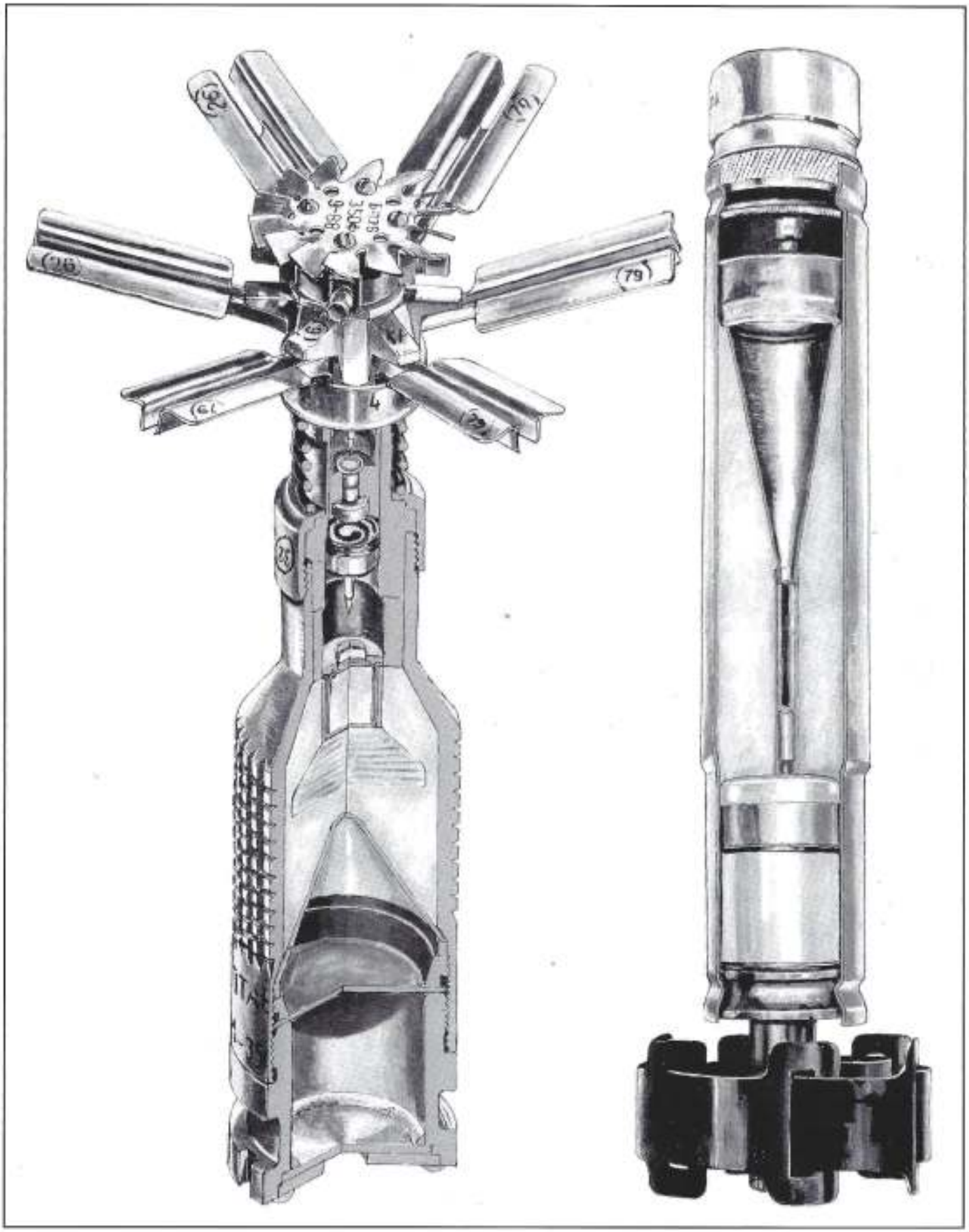


PTAB-1.5 (left), PTAB-2.5 (right) and PTAB-2.5M (centre), which was used extensively in Afghanistan. PTAB-2.5M uses a vane-armed electrical nose fuze to initiate a 'spit-back' detonator; this consists of an initiator in the nose fuze which fires into a flash receptor at the apex of the shaped charge cone. This initiates the detonator and booster at the base of the cone to detonate the HEAT warhead (Lyn Haywood) 0074730



PTAB-2.5KO (left) and obsolete PTAB-1M (right) fin-stabilised anti-armour submunitions. The PTAB-2.5KO has been used in Afghanistan and Chechnya; note that it uses a vane arming system and simple inertia base fuze with a stab-sensitive detonator (Lyn Haywood) 0074729

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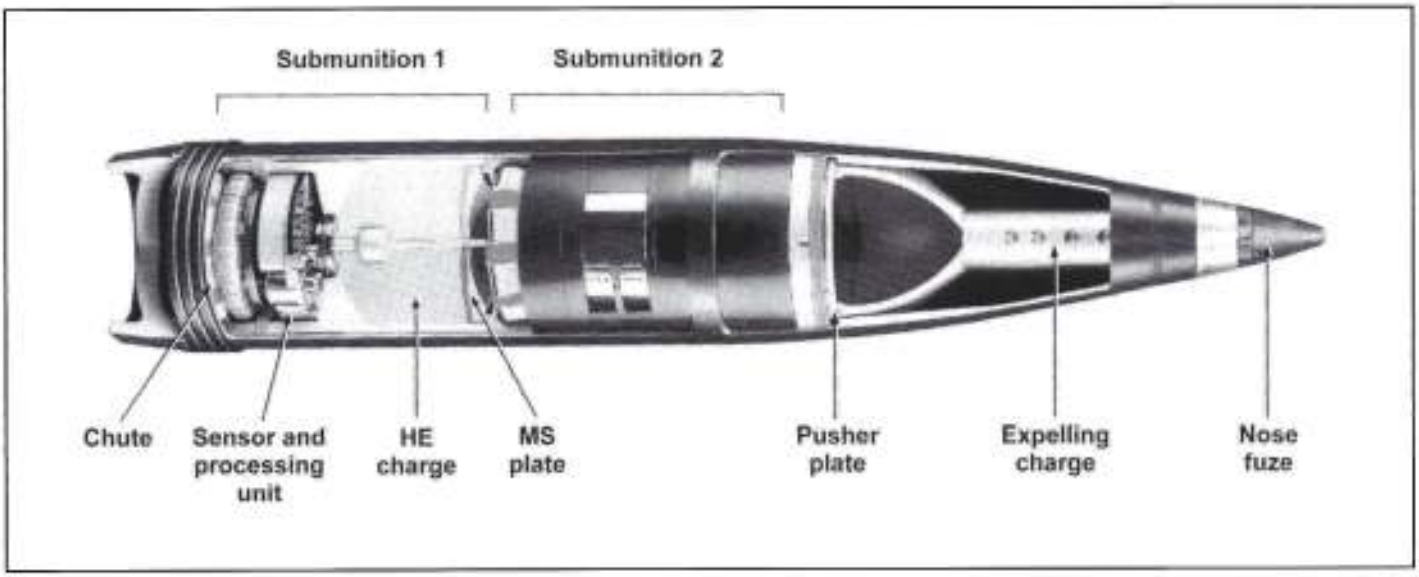
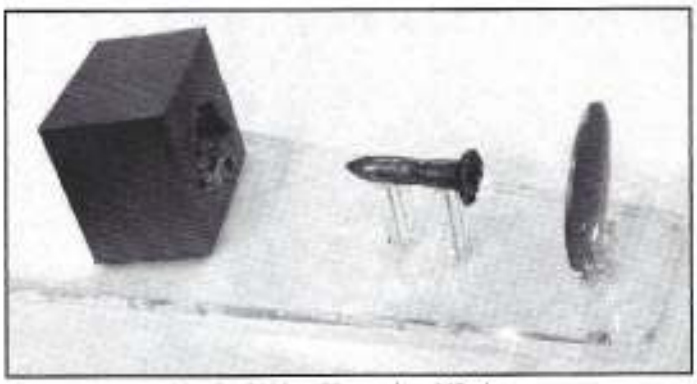
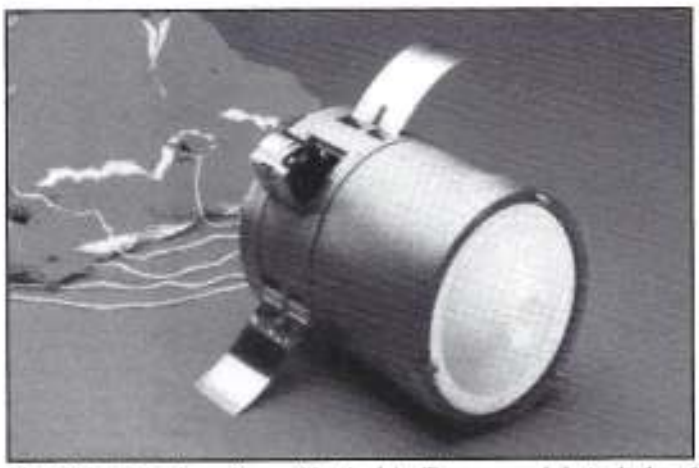


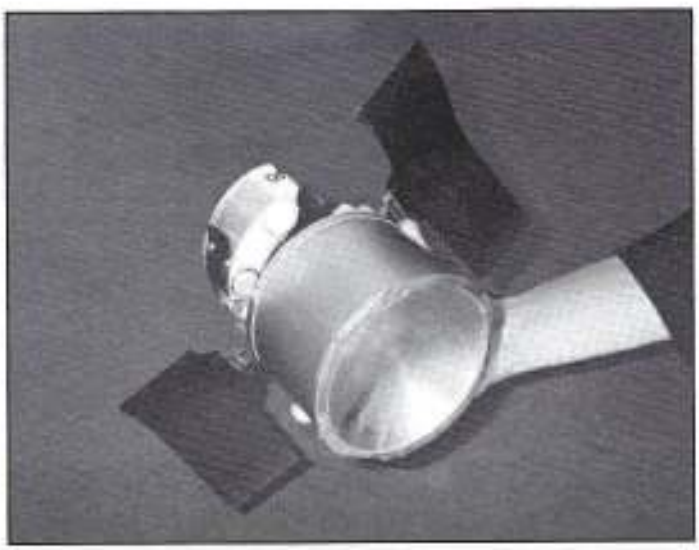
A cutaway of the SMArt 155 projectile 1375975



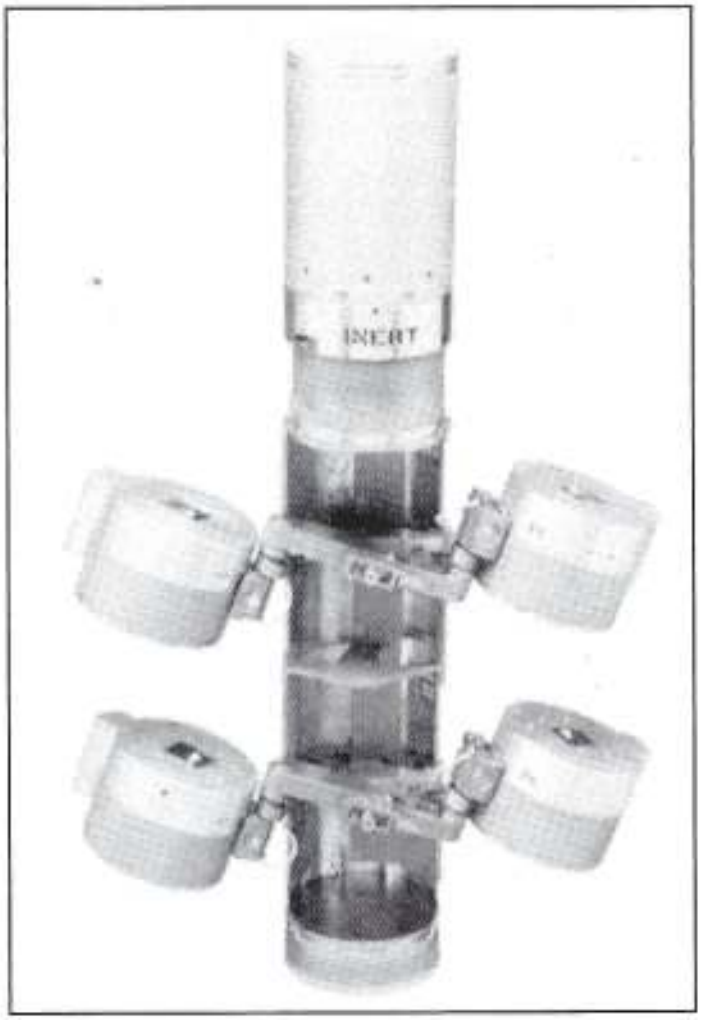
The EFP produced by the SMArt 155 tantalum MS plate
(Colin King) 1375976



The SMArt 155 submunition, with winglets, IR sensor and chute deployed
(GIWS) 1375977



The BONUS submunition, in its attack configuration
(Colin King)
1376978



The US 'Sensor Fuzed Weapon' (SFW) contains ten of these BLU-108 submunitions, each incorporating four 'Skeet' warheads. SFW has been deployed in Iraq 0573817

SENSOR-FUZED SUBMUNITIONS

Description

Sensor-fuzed submunitions are the only bomblets capable of complying with the terms of the Convention on Cluster Muntions (CCM), since they can discriminate and attack individual targets, and are powered by batteries. However the legislation also specifies that allowable types must incorporate Self-Destruct (SD) and Self De-Activation (SDA) devices, weigh more than 4 kg and include no more than 9 submunitions within a single carrier.

The US BLU-108 is a submunition which incorporates four 'Skeet' Misznay Schardin (MS) warheads, each weighing 3.4 kg. The air-launched Sensor Fuzed Weapon (SFW) dispenses ten BLU-108s, making a total of 40 warheads. Although the Skeets have both SD and SDA features, their weight and number mean that they fail to comply with CCM legislation.

The German SMArt 155 and Swedish/French BONUS are similar artillery-launched submunitions. Both systems use a base-ejection 155 mm carrier projectile to dispense 2 submunitions, each of which incorporates sensors, a high-performance MS warhead with tantalum (heavy metal) liner and SD/SDA fuzing.

The Russian SPBE and SPBE-D submunitions are dispensed using RBK-500 cluster bombs, holding 14 SPBE or 15 SPBE-D. A version known as MOTIV-3M can be carried in the 9N152 warhead for the 300 mm 'Smerch' artillery rocket (5 submunitions).

Operational details

Typical operation

BLU-108 Once ejected from the parent munition, a rocket motor fires to lift the BLU-108 and induce spin. The Skeets are then released, retaining an eccentric spin that allows their sensors (dual-mode IR and laser) to scan the ground. Once a valid target has been identified, the MS warhead is detonated to produce a copper Explosively Formed Penetrator (EFP) and 16 smaller fragments. If no valid target is identified, the Skeet will self-destruct; if the SD fails, the reserve battery will self-deactivate within minutes.

BONUS and SMArt-155 Both of these systems operate in a similar manner, with the projectile's nose fuze initiating an ejection charge to expel two submunitions. The submunitions activate their reserve batteries and deploy their sensors and winglets, spinning eccentrically so that they scan a spiral pattern on the ground as they search for targets. The SMArt submunition deploys a small chute and uses an IR sensor combined with millimetric radiometer and radar. BONUS uses multi-spectral IR, with the most recent version also incorporating a 5-beam laser radar (LADAR). Once a valid target has been identified, the MS warhead is detonated (in mid air) to produce a tantalum EFP. Both systems incorporate two independent SD modes (impact and delay) and will self-deactivate when the reserve batteries run down, if the SD should fail.

SPBE, SPBE-D and MOTIV-3M These submunitions have parachutes and IR sensors on a large (186 mm diameter) MS warhead containing 4.5 kg of HE. Operation is similar to that described above.

EOD considerations

- A soak period should be allowed for SDA
- Approach within view of the sensors should be avoided
- Demolition techniques should minimise EFP formation
- Provision (such as sand bags) should be made to stop the EFP.

Typical specifications

Example	BLU-108	BONUS	SMArt-155
Delivery:	Air: Sensor Fuzed Weapon	155 mm projectile	155 mm projectile
Number in dispenser:	10 (each with 4 × Skeet warheads)	2	2
Diameter:	BLU-108: 133 mm	138 mm	138 mm (est)
Length:	BLU-108: 790 mm	200 mm (est)	200 mm (est)
Weight:	BLU-108: 29 kg (Skeet: 3.4 kg)	6.5 kg	n/k
CCM compliant:	No	Yes	Yes

Notes

Relevant extracts from the Convention on Cluster Munitions are given under the entry *Submunitions – General*. For more detail of the SPBE, SPBE-D and MOTIV-3M, see *Production tables* for submunitions.

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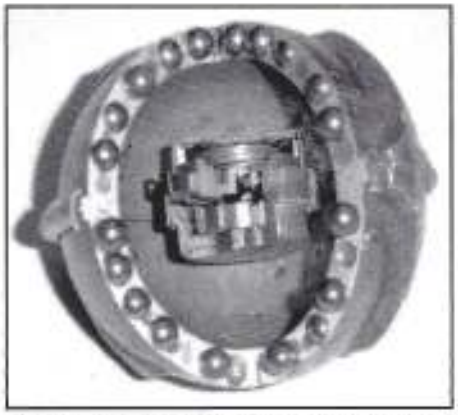
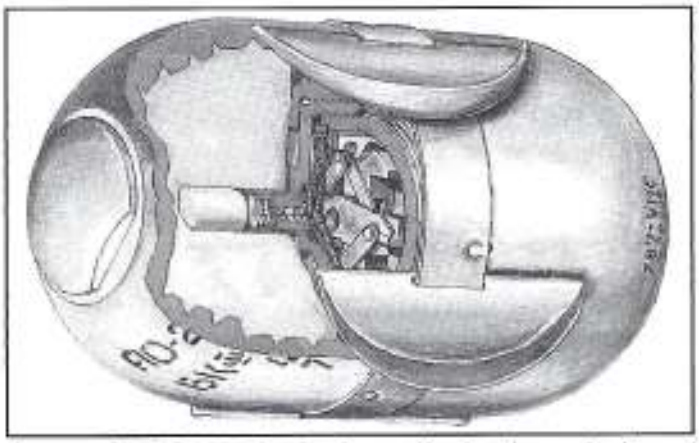
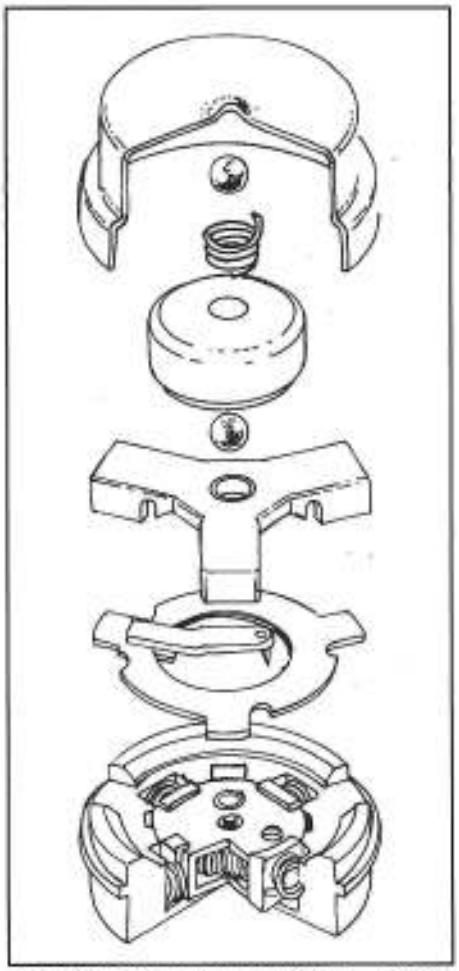
US spin-armed submunitions in Cambodia. From the left: BLU-26/B, BLU-61/B and BLU-42/B. The BLU-42/B dispenses tripwires and is therefore classified as a mine (Colin King) 0074220



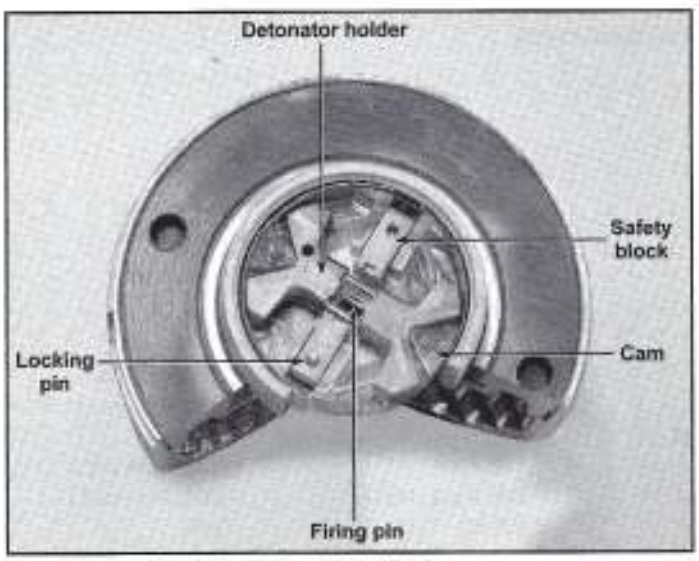
Cutaway of the US BLU-26/B, showing the central spin-armed fuze. Note also the ball bearings set into the aluminium casing. The Russian ShOAB-0.5M appears to be a direct copy (Colin King) 1121130



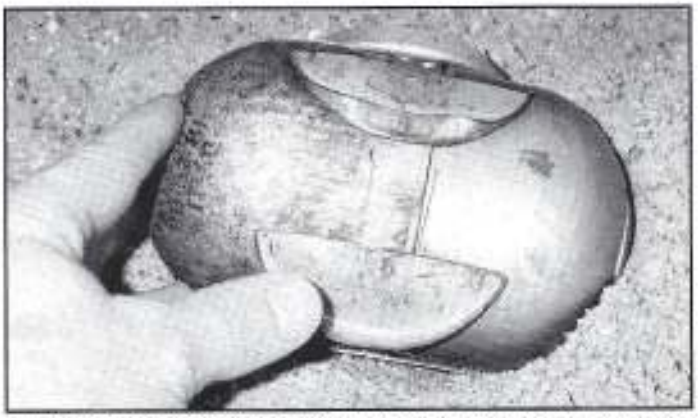
Cutaway of the AO-2.5RT showing the centrifugal arming mechanism and one of the delay detonators (Lyn Haywood) 0074131



The M219E1 fuze from the BLU-61/B 0074132



Components of the AO-2.5RT fuze (Colin King) 1375956



The Russian AO-2.5RT bomblet, which splits into two halves on impact, before detonating (Colin King/DEODS) 0546818

The two varieties of US BLU-66, which is based on BLU-24 with a modified tail (Colin King) 1041049

SPIN-ARMED SUBMUNITIONS

Description

Spin-armed submunitions are dispensed from cluster bombs dropped from fixed-wing aircraft. Most are basically spherical, though the Russian AO-2.5RT and AO-2.5RTM have parallel-sided bodies with hemispherical ends. All types have external vanes to induce spin as they fall from the dispenser; these may be incorporated into the shape of the casing or fixed onto it in the form of a band or tail assembly. The body is normally cast steel and may be internally or externally notched to improve fragmentation; some of the US variants (such as BLU-26/B and the Russian copy, ShOAB-0.5M) are made from aluminium with steel balls set into it. In some designs (such as BLU-61/B) the steel body is covered with an outer plastic casing. The body tends to be made in two halves, which may be crimped together or joined using a metal band; in the AO-2.5RT, this band also incorporates the spinning vanes. In most cases, the fuze mechanism is in the centre of the submunition, surrounded by the main charge; this protects it from corrosion, but makes it impossible to know whether or not the fuze has been armed.

Operational details

Typical operation

When dispensed at sufficient altitude, the vanes impart spin to the bomblet as it drops. Centrifugal force is used to arm the fuze once the speed of rotation is high enough, with sprung weights moving outwards to release a spring-loaded rotor or slide containing the stab-sensitive detonator; this may also bring the detonator into line beneath the firing pin and lock it in place. Most bomblets then function on impact, though some (such as the US BLU-24 and BLU-66) are also initiated by a decrease in centrifugal force. For impact initiation, the all-ways acting fuzes use weights, either falling directly on the firing pin, bearing on it at a tangent as they ride down internal slopes, or forcing ball-bearings out of tapered recesses (see diagram of the M219E1 fuze). Most spin-armed submunitions detonate immediately on impact, though some (such as AO-2.5RT, BLU-86/B and BLU-86A/B) incorporate a short delay. The AO-2.5RT is blown into two halves by a small charge that also ignites short pyrotechnic delays to detonators in each half. On detonation, the body is shattered, with fragments travelling in all directions. In an unexploded submunition, an all-ways acting fuze mechanism can behave like an anti-disturbance device and may function if subjected to sudden movement. Spin-armed submunitions do not incorporate self-destruct devices.

EOD considerations

- Spin-armed submunitions are often left unexploded in the fully-armed condition
- These bomblets are prone to failure if they strike soft ground or if their descent is slowed by vegetation
- Armed submunitions with all-ways acting fuzes can be sensitive to inertia and impact
- Despite external corrosion, all-ways acting mechanisms and stab-sensitive detonators may be fully operational after many years
- Most spin-armed submunitions cannot be neutralised or rendered safe; they should be destroyed *in situ* wherever possible
- The presence of an unexploded spin-armed submunition indicates that others are likely to be present nearby
- Some tripwire-operated mines (such as BLU-42/B) are very similar in appearance.

Typical specifications

Example	Russian AO-2.5RT	US BLU-61A/B	US BLU-26/B (Russian ShOAB-0.5M)
Diameter:	90 mm	99 mm	64 mm
Length:	150 mm	n/a	n/a
Weight:	2.5 kg	1.2 kg	454 g
Explosive weight:	500 g (est)	277 g	85 g
Explosive type:	RDX/TNT	HMX/TNT	RDX/TNT

Notes

All of the bomblets mentioned in this entry are banned under the terms of the Convention on Cluster Munitions (CCM); see *Submunitions – General*. US spin-armed submunitions were used extensively in South East Asia, particularly in Laos. Russian AO-2.5RT bomblets were used in Afghanistan and Chechnya; AO-2.5RT and ShOAB-0.5M were used in Tajikistan. The US BLU-61, which was used in Iraq, Kuwait and Lebanon, has a liner of Zirconium/Tin to give a pyrophoric effect. See also National production tables for submunitions in the *Data summary* section, and separate entries: *Cluster bombs* and *Russian submunitions*.

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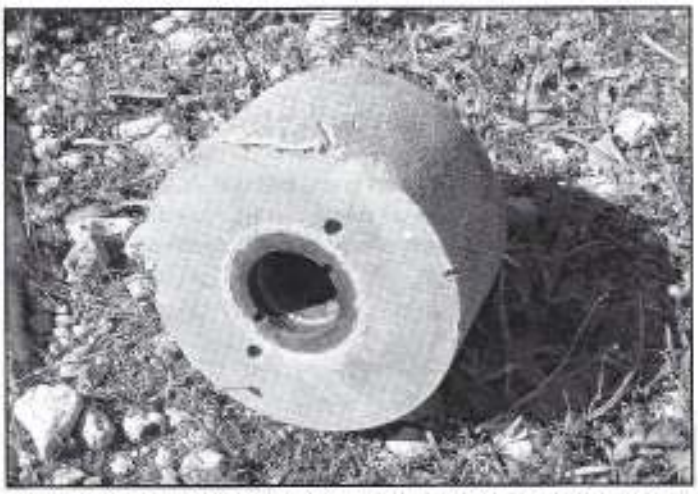
The characteristic signature made by dual-purpose submunitions on a road surface in Kuwait. The arcs caused by fragmentation are consistent in shape and all point in the same direction; this indicates the direction from which the attack came and suggests that these were fin-stabilised bomblets. Unexploded bomblets can be expected in the soft sand to the side of the road (Colin King) 0074734

Empty US Mk 6/7 'Rockeye' dispenser in Kuwait, showing the Mk 339 time fuze. Note also the cut along the base of the casing, produced by the linear cutting charge (Colin King) 0074259

Half of a US SUU-30B/B container, used as CBU-52/B to dispense BLU-61/B spin-armed submunitions during the first Gulf War (Colin King) 1041048

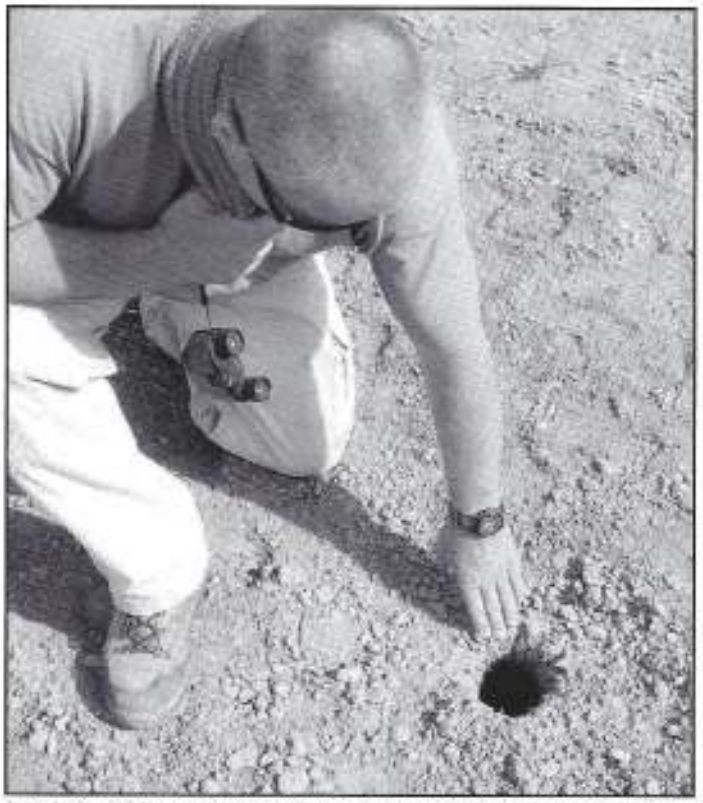
The tail of an MLRS rocket indicates a nearby DPICM strike (Colin King) 0573818



Burned-out base bleed units were among the key signatures of cluster projectile strikes in Lebanon (Colin King) 1375954

SUBMUNITION STRIKE SIGNATURES

The effects of Mk 118 'Rockeye' dual-purpose warheads on a tank turret (Colin King) 0074735



Iraq: holes left by BLU-97 unexploded submunitions, which struck when the ground was wet (Colin King) 1121135

Kosovo: this impact mark from a US BLU-97 shows the crater made by the shaped charge and the spread of anti-personnel fragments, which have penetrated the 6 mm steel railings (Colin King) 0074732

Trees in Kosovo, damaged during a BL-755 strike (Colin King) 0546812

Evidence of two overlapping submunition strikes; the plastic components are fins and spacers from US Mk 118 'Rockeyes', while the metal caps are from US BLU-97s (Colin King) 0074733

Indications of a DPICM strike include ribbons, packing pieces and spacers (Colin King) 1310630

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EQUIPMENT

Communications equipment
Containment and damage prevention
Countermeasures/Jammers
Detection equipment – Metal detectors (Portable)
Detection equipment – Metal detectors (Fixed)
Detection equipment – Vehicle mounted detectors
Detection equipment – Explosive detectors
Detection equipment – Other detectors
EOD tools and equipment
EOD weapons
Explosives, pyrotechnics and demolition accessories
Imaging and monitoring
Personal protective equipment (PPE)
Training aids/simulators
Vehicles: remote control
Vehicles: specialist and protected

COMMUNICATIONS EQUIPMENT
Canada

HW-300 hardwire communication system

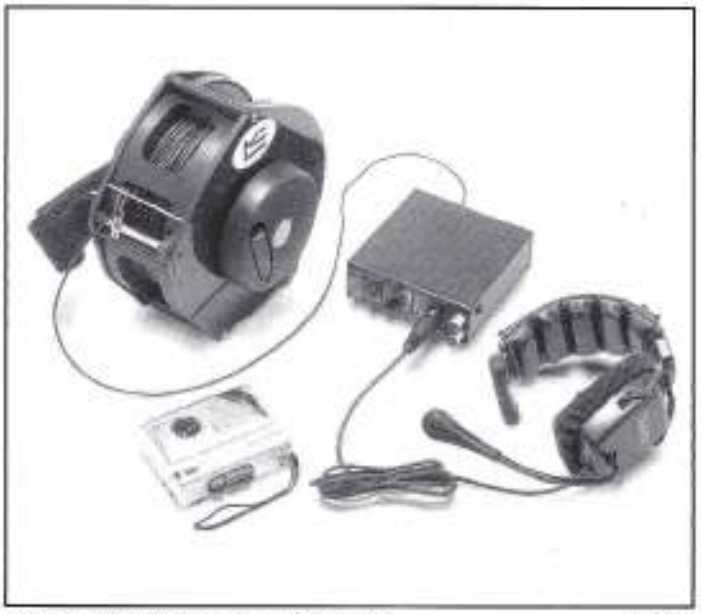
Description
The HW-300 hardwire communication system is designed for use between an EOD or Improvised Explosive Device Disposal (IEDD) operator and the command post. A hardwire communication system should reduce the risks of transmitting radio frequency (RF) signals into an improvised explosive device (IED). The HW-300 includes a combined remote-control module and spool, 125 m (410 ft) of low-friction cable, command-post module, tape recorder and carry bag.

Other features of the HW-300 include a contoured form for improved fit and stability to the outside of the user's leg, tangle-free tracking during extension and retraction of the cable and a fold-in handle to avoid restricting the user's mobility.

Specifications
Approximate weight: 4 kg
Power supply: 9 V alkaline batteries
Cable length: 125 m
NATO stock number: 5830-21-920-5632

Status
In production and in service.

Contractor
Med-Eng Systems Inc.



HW-300 components (Med-Eng Systems) 0125379

MK 700 EDU wireless EOD communication system

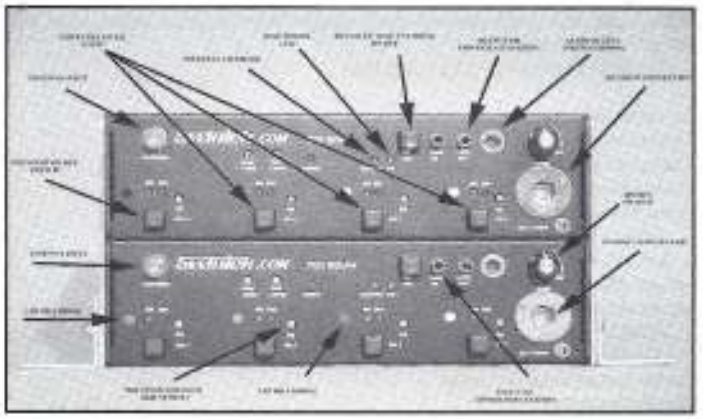
Description
The MK 700 EDU line of communication equipment has been specifically designed for use by bomb disposal teams. Four different systems are available, and customise solutions can also be engineered.

The design is intended to provide a hands-free communication link between a bomb technician wearing a bomb suit, and the 'Number 2' bomb technician, who does not normally wear a bomb suit. Larger systems are also available.

For safety purposes the actual radiated power of the transmitter portion of the transceiver is approximately 100 mW. Voice operated switching (VOX) is considered unsuitable due to operational requirements. The system is full duplex and requires a minimum of two frequencies in order to operate. Most systems feature a re-broadcasted side tone to confirm reception of the audio link. The range is approximately 300 m.

The transceivers are housed in a metal case and powered by AA batteries. There is a spring style metal clip for attaching the transceiver to a bomb suit (if necessary); leather pouches are also supplied that can be worn on a belt. The headsets supplied with the system have antenna mounts to ensure that the antenna is radiating away from the body in order to optimise range. A ground plane is provided with the headset. Normally, bomb suit helmets have built in microphone/headset combinations and will readily interface with the transceiver.

The MK 700 EDU system was originally developed as a module for the MedEng range of bomb suits (see separate entries). When mounted to the EOD-8 and later suits with the communications pack, the transceiver will receive power from the bomb suit communications package.



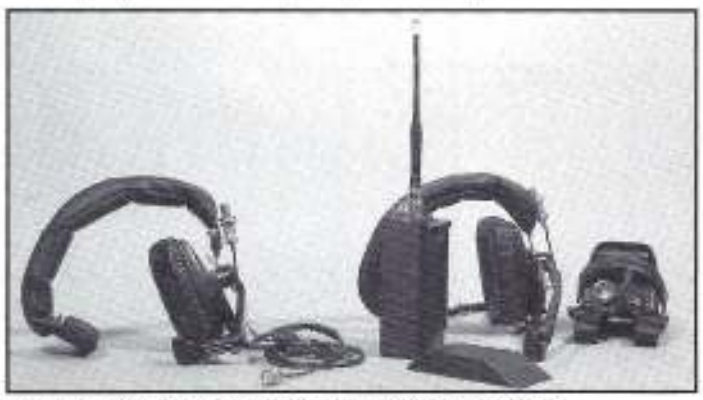
MK 700 EDU base station (CinequipWhite Inc) 0101971

Each system has different capabilities and has been designed to be used in slightly different ways, although all have full duplex capability.

System One
System One is designed to be used by two people: a 'Number 1' command technician and the 'Number 2' assistant technician, dressed either in bomb suits or in uniform on the range. Headsets are supplied to enable it to be used without the bomb helmet that normally supplies the headset interface.

System Two
System Two has additional accessories. A portable receiver that can be mounted into a vehicle or worn by a technician and an earpiece are supplied, along with a cassette recorder and a small speaker.

System Three
System Three allows three people to be in full duplex communication. The system has a base station that incorporates two receivers and one transmitter. The base station can be mounted into and powered by a vehicle, or it can be used as a portable base station powered by on-board batteries. Stereo output is provided to enable a recording of the event to be made. One transceiver is recorded on the left channel while the other is recorded on the right channel. The base station audio is mixed across both tracks. This system requires three frequencies.



Headsets are provided for use without bomb suit helmets (CinequipWhite Inc) 0101972

For details of the latest updates to *Jane's Explosive Ordnance Disposal* online and to discover the additional information available exclusively to online subscribers please visit **jeod.janes.com**

System Four
System Four allows five people to be in full duplex communication, responding to the need for a double entry team with backup and a commander. The base station can be tied into a larger radio net through the 'line in' and 'line out' features. At the base station, individual receivers can be turned off as required. The base unit can be powered by a 12 V DC vehicle battery or by AC power. The base has an internal rechargeable back-up battery which automatically cuts in should the other power sources fail.

Specifications
Frequency of operation: 220.00 to 245.000 MHz and 425.00 to 510.000 MHz
Frequency stability: crystal controlled to ±0.0025%
Transmitter power
transceiver: <250 mW into 50 Ω antenna
base station: <1 W into 50 Ω antenna
Deviation: 5 kHz at full modulation
Power supply: Motorola style flip phone battery, alkaline AA battery, Ni-Mh, Lithium ion, Ni/Cd batteries or MedEng EOD7, EOD7B and EOD8 power packs
Receiver sensitivity (min): 110 dBm at 12 dB SINAD
Selectivity: better than 60 dB
Controls: external on/off switch with volume, internal squelch and microphone level
Transceiver
dimensions: 120 × 87.5 × 37.5 mm
weight: 0.5 kg

Status
In production and in use.

Contractor
CinequipWhite Inc.

Germany

CT-DECT Case wireless communication system

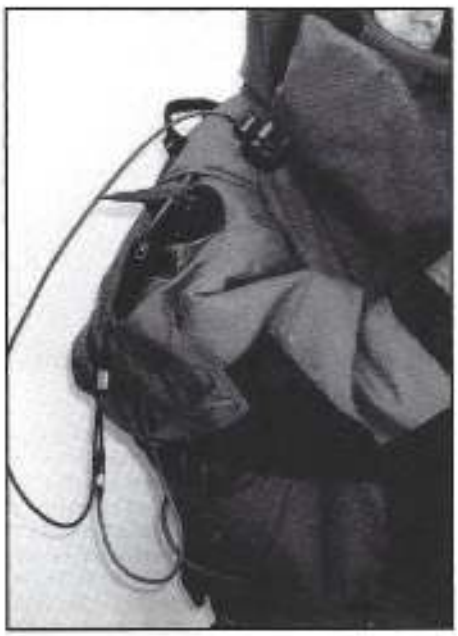
Description
The CT-DECT system is designed to provide two bomb disposal personnel with digital, full duplex communication. Each operator has a communication set integrated into an EOD helmet and a CT-DECT module fixed to the outside of a bomb suit. Communication between the users is digital, wireless, fully duplex and secure. The range is up to approximately 100 m and any channel in the 2 m band can be used. The CT-DECT module has an average transmission output of 10 mW (a transmission output of 250 mW can be achieved for short time transmission bursts).

The module has a large Push To Talk (PTT) button that enables the operators to communicate with the main control post via the CT-DECT interface case. The interface case can be located at a distance of 1 to 4 km from the main control post, depending on local conditions and transmission power.

A training system is also available.

Specifications
Frequency range: 1,880–1,990 MHz
Channel separation: 1,728 MHz
Channel selection: automatic
Transmission output DECT
average: 10 mW
max: 250 mW (+24 dBm)
Range DECT: max 200 m
Operating time
CT-DECT module with Li ion battery: 20 h
CT-DECT interface case: 48 h DECT
Radio transmission output: 1–10 W
Operating time:
1 W (80% standby, 10% transmitting, 10% receiving): 16 h
10 W (80% standby, 10% transmitting, 10% receiving): 11 h

Contractor
CeoTronics AG.



CT-DECT wireless, digital duplex communication system (CeoTronics)
0587887

CT-DECT interface case (CeoTronics) 0587888

CT-DECT module (CeoTronics)
0587886

United Kingdom

Comtrack Command, Control and Information System (C^2IS)

Description

Comtrack is a Command, Control and Information System (C^2IS) developed specifically to meet the requirements of a nationwide, multi-service EOD community.

Each system is tailor-made to the customer's requirements. Comtrack enables the acquisition, processing, management distribution and presentation of essential operational information by integrating a number of communication and information applications such as:

- GPS;
- public and military communications;
- Global System for Mobile communications (GSM); GPRS and
- mapping.

Comtrack is designed to allow rapid, accurate transmission and receipt of voice and visual communications, text, data and graphics, thus allowing comprehensive information exchange between specialist mobile teams, support vehicles, static sub-units and headquarters.

In addition to mobile e-mail, graphics/file transfer and database access facilities, the system also incorporates a complete mission record and playback facility, which can be used for tactical briefing, operational analysis and training.

Status

Available. In use in the UK.

Contractor

Terrafix Limited.

CONTAINMENT AND DAMAGE PREVENTION

Canada

Suspect pack container SPC-500

Development
BOSIK designed the SPC-500 to allow personnel to safely remove a threat and continue normal operations while waiting for trained personnel to deal with the package. It is designed for letter bombs and electronic devices but can be custom manufactured for other applications such as waste receptacles. The SPC-500 is suitable for use in post offices/ mailrooms, aviation security, onboard aircraft, embassies, government buildings and so on.

Description
The BOSIK total containment suspect pack container SPC-500 is a lightweight, portable container that can completely contain a bomb blast, resulting gases and chemical and biological threats. An exhaust valve is fitted for controlled venting following detonation.

The SPC-500 is two-man portable and has castor wheels fitted for easy manoeuvrability It is compatible with EOD robots and can be custom designed on request. The container can fit through most doorways, elevators and hallways.

The BOSIK suspect container has been subjected to rigorous field tests which were conducted in conjunction with the Royal Canadian Mounted Police (RCMP) Explosives Disposal Unit (EDU) and Transport Canada (TC).

Specifications
Dimensions overall:

(width)	60 cm
(height)	63.5 cm
(depth)	56 cm

Dimensions door:

(width)	25 cm
(height)	3.8 cm

Weight: 58 kg

Status
In production.

Contractor
BOSIK Security Containment Systems Ltd.

Model SPC-500 total containment suspect package container
(BOSIK)
1334711

The SPC-500 is designed for electronic devices
(BOSIK)
1334712

France

Confining containers for explosive transportation and storage

Description
The P0.5, P2 and P10 Protectainer family is designed to confine blast and fragments from 0.5 to 10 kg TNT or equivalent. The containers are easy to use, simple to maintain and are claimed by the manufacturer to provide superior protection over traditional protective containers. Used in France by police departments, army and civil aviation, air and sea port authorities, the containers could be customised to meet clients' individual requirements.

Status
No longer in production.

Contractor
Nexter.

Confining container P10
0005093

Ground Bomb Killer (GBK)

Development
SEMA has developed and patented the Ground Bomb Killer (GBK), an effective anti-bomb protection solution. It has been designed for use in: airports, train and underground stations, government buildings, museums, conference centres, banks and other public spaces.

Description
GBK ensures users' safety with a ballistic belt that is placed over the suspicious object to protect the surrounding area until a specialised response team arrives. The GBK is easy to use with fast implementation and no special training required.

The GBK has a V50 rating of 665 m/s using STANAG 2920 specifications. It is resistant to a horizontal force of up to 15 tonnes.

Specifications

	Application	Length	Width	Height	Weight
Medium	hand luggage	1.47 ft	0.98 ft	1.47 ft	32 pds
Medium +	hand luggage	1.47 ft	0.98 ft	1.47 ft	46 pds
Medium S+	hand luggage	1.47 ft	0.98 ft	1.47 ft	68 pds
Standard Mini	luggage	2.94 ft	1.31 ft	1.98 ft	63 pds
Standard	luggage	2.94 ft	1.31 ft	2.45 ft	74 pds
Large	trolley	3.61 ft	1.31 ft	2.94 ft	96 pds

Status
In production.

Contractor
SEMA.

GLS Ground Bomb Killer (GBK)
(Patrick Allen/Jane's)
1345026

GLS Ground Bomb Killer (GBK)
(Patrick Allen Jane's)
1345024

Metallic safety packing

Description
This family of metallic boxes is specially designed for the storage and transport of ammunition, explosives and other pyrotechnic products. The boxes are made of steel, are particularly resistant to the severest conditions for use and comply with United Nations specifications.

Major characteristics include: body and cover stamped without welding and equipped with stacking ribs; anti-corrosion protection for storage in all climates; levered clasps welded to the body; carriage by fold-down metallic handles; watertight when immersed; reusable; air transportable. They are available in a range of volumes from 10 to 37 dm^3.

Status
No longer in production.

Contractor
Nexter.

Metallic safety packing
0005091

Germany

Bomb blanket with ballistic container

Description
This set consists of a ballistic container and blanket designed to contain the blast and fragmentation from a suspect device.

The bomb blanket is manufactured from multiple layers of TWARON®. In the centre the layers are doubled. A 400 × 400 mm TWARON®/rubber laminate sheet gives added protection against penetration caused by the blast. The ballistic container is also manufactured from multiple layers of wrapped TWARON®-fabric. The outer layer is made from rubberised fabric of the same material. The fabric is wound both horizontally and vertically before being bonded by a special adhesive which gives a high tensile strength to the whole structure and has a specially reinforced bottom.

In use the container is placed over the device and the blanket is then placed over the top. The container is fitted with carrying handles for ease of movement and placement. The set, combined with a hook and line system, is used by several EOD units in Central Europe.

A larger container is also available. This has been successfully demonstrated using a hand grenade containing 120 g TNT and 5,000 fragments.

Specifications
Container (small)
internal diameter: approx 400 mm
internal cylindrical height: approx 380 mm
weight: approx 24 kg

Ballistic container
(ELP GmbH)
0074361

Container (large)
internal diameter: approx 530 mm
internal cylindrical height: approx 750 mm
weight: approx 29 kg
Blanket
dimensions: approx 2.2 × 2.2 m
weight: approx 17 kg

Status
In production and in service.

Contractor
ELP GmbH.

Bomb blanket with ring

Description
This set consists of a ballistic ring and blanket designed to contain the blast and fragmentation from a suspect device. The equipment is intended for use as a first response, before the arrival of EOD/Improvised Explosive Device Disposal specialists. The ring is placed over the suspicious object and then covered by the blanket. It is still possible to view the device with x-ray equipment. Removal of the blanket from a suspected device is carried out using one of the loops located on each side of the blanket.

The bomb blanket is manufactured from multiple layers of TWARON®. A 600 × 600 mm TWARON®/rubber laminate sheet gives added protection against penetration, should a blast occur.

The ballistic ring is also manufactured from multiple layers of wrapped TWARON® fabric with the outer layer being rubberised. The fabric is wound both horizontally and vertically before being bound by a special adhesive, providing a high tensile strength.

The reinforced ring is put over the suspicious object and covered by the blanket. The IED specialists are still able to x-ray the covered object. Two fabric straps on each side of the blanket are used to remove it from the suspect object, using a hook and line system or a remote-controlled manipulating vehicle.

Specifications
Container
internal diameter: 530 mm
external diameter: 580 mm
internal cylindrical height: 265 mm

Bomb blanket with ring (ELP GmbH) 0074362

Blanket
dimensions:
Main blanket: 2,200 × 2,200 mm
Reinforced centre: 600 × 600 mm
weight approx: 17 kg

Status
In production and in service.

Contractor
ELP GmbH.

Letter bomb containment bag

Description
The letter bomb containment bag is designed to contain the accelerated hard fragments produced by the explosion of such a device.

The bag has been tested by the Ministry of Interior, Vienna, with a charge of 50 g of plastic explosive; test reports on a real case when two letter bombs detonated simultaneously are available on request.

The bag will carry an envelope up to DIN A4 size and approximately 40 mm thick. The non-opening side, is reinforced with a rubberised laminate to give added protection against blast perforation. A special exchangeable cloth, vacuum metallised on both sides, gives additional protection against radio interference's. In tests and incidents it was proven that all fragments caused by the explosion were captured inside the bag and could be handed over to the forensic laboratory for analysis.

For X-raying a suspected letter can remain in the bag. The bag materials will not dilute the quality of the X-ray image.

Specifications
Dimensions: approx 400 × 300 × 40 mm
Weight: approx 3.3 kg

Status
In production. In service throughout Central Europe and in the UK.

Contractor
ELP GmbH.

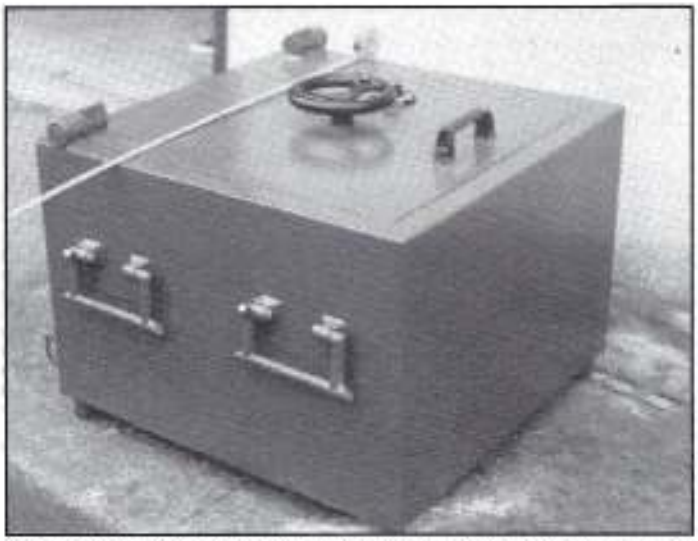
Letter bomb containment bag (ELP GmbH) 0074360

MEL 236 Detonation containers

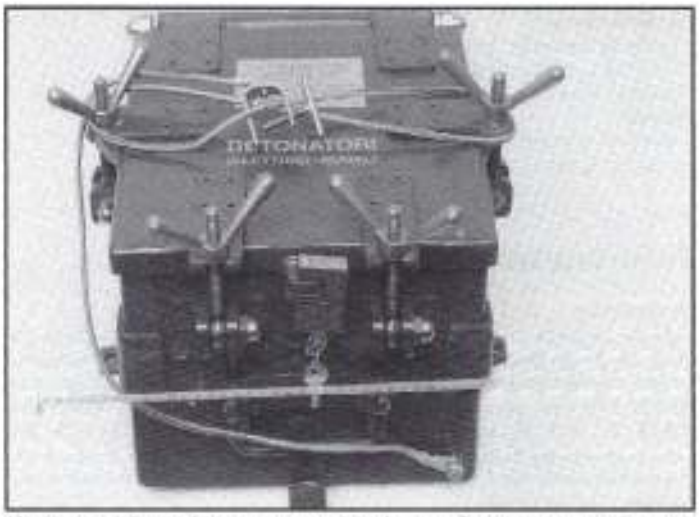
Development
The MEL 236 detonation containers are made up of two series. The first series are designed to carry and stock detonators used by units appointed for anti-sabotage or explosive ordnance disposal (EOD) operations. The second series of containers are particularly suitable for special units which can also operate in water (submarines).

Description
The MEL 236 detonation containers are heat-proof, mechanical stress-proof and impermeable to electro-induction and are primarily made of titanium.

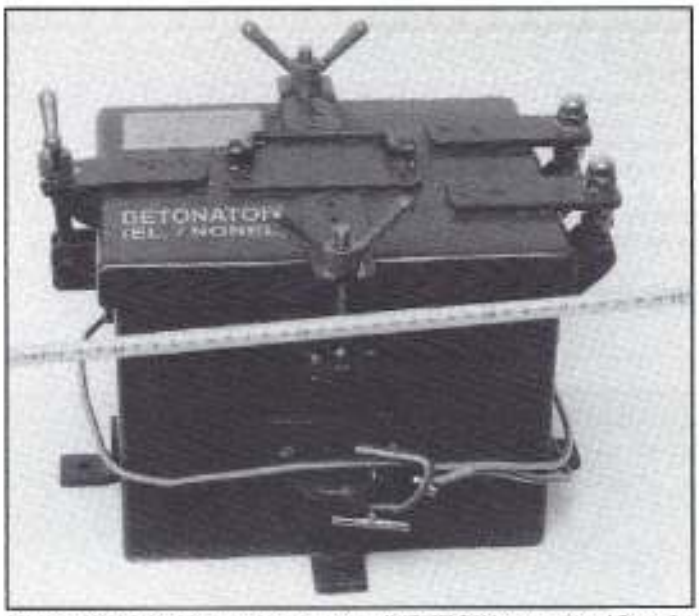
Version 7 MEL 236 detonation container (MELTRON International Security Services) 1298753



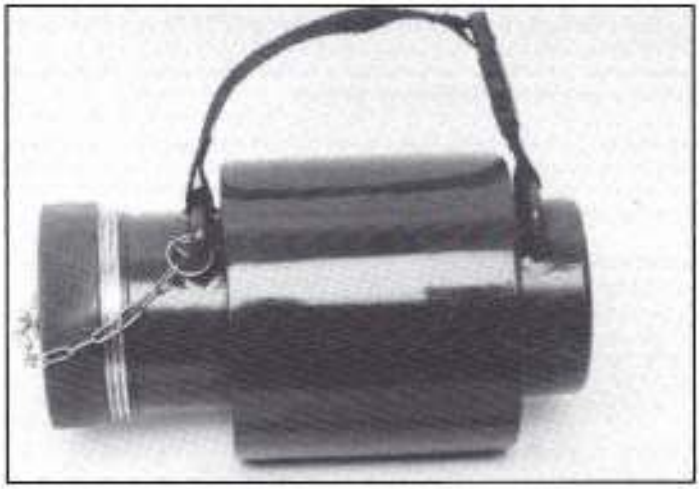
Version 4 MEL 236 detonation container (MELTRON International Security Services) 1298750



Version 3 MEL 236 detonation container (MELTRON International Security Services) 1298749



Version 5 MEL 236 detonation container (MELTRON International Security Services) 1298751



Version 6 MEL 236 detonation container (MELTRON International Security Services) 1298752

The first series consist of three parallel piped containers, versions 3, 4 and 5, with a respective capacity of 150, 12 and 6 detonators of any kind (with fuse, electrical, nonel and at percussion) ONU 1.4S ratified by the Italian Ministry of Defence and Interior Ministry.

The second series consist of two cylindrical containers, versions 6 and 7, with a respective capacity of 8 and 3 detonators of any kind. They are water-tight up to 70 m deep and can be launched by an operator or dropped from an aircraft.

Status
In production.

Contractor
MELTRON International Security Services GmbH.

TEL 230/1 and TEL 230/2 bomb blanket sets

Description
These bomb blankets are designed to provide temporary protection from a suspect device during the evacuation of personnel, or if dealing with more than one suspicious object at the same time. The set consists of an adjustable ring which is placed around the object and either one (TEL 230/1) or two (TEL 230/2) blankets to cover the top. Both components are manufactured from ballistic aramid fibre covered with cordura.

Specifications
Blanket
Weight: approx 4 kg
Size: 1.5 m² × 1.5 m²
Material: aramid fibre
Outer material: cordura
Number of handles: 4
V_{50}: 192 m/s (according to STANAG 2020)

Ring
Weight: approx 0.9 kg
Length: 1.9 m
Diameter: 0.6 m
Material: Aramid fibre
Outer material: Cordura
V_{50}: 192 m/s (according to STANAG 2020)

TEL 230/1 bomb blanket (telerob) 0077646

Status
No longer in production.

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.

TEL 600-3 bomb containment vessel

Description
The TEL 600-3 bomb containment vessel was designed for the transportation of suspicious objects. The trailer-mounted vessel was designed and tested for 5 kg of TNT. The large opening formed by the two half shell design allowed easy access with manipulator vehicles and manipulation sticks. A built-in net kept objects in the centre of the vessel.

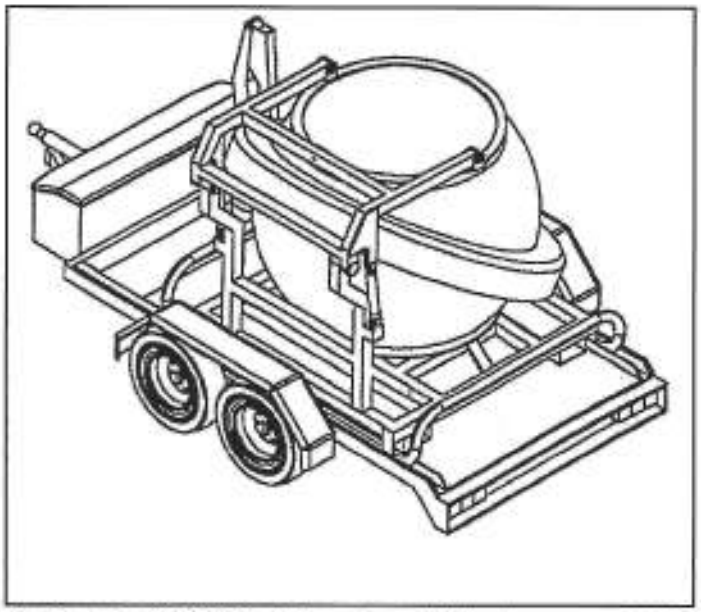
The low total weight including trailer enabled the system to be pulled by a standard vehicle. The trailer could be fitted with a variety of coupling systems and an optional manipulator arm was available.

Specifications
Container
Capacity: 5 kg TNT equivalent
Ballistic protection: 520 m/s (according to STANAG 2920)
Weight: 850 kg

Trailer
Axles: 2
Total weight (incl vessel): 1,600 kg

Manipulator arm
Degrees of freedom: 7
Carrying capacity: 30 kg
Power supply: built-in battery system

Status
No longer in production. In service with several military and police EOD/IEDD teams worldwide.



Drawing of the TEL 600-3 containment vessel (telerob) 0077842

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.

Italy

ETEM security structures

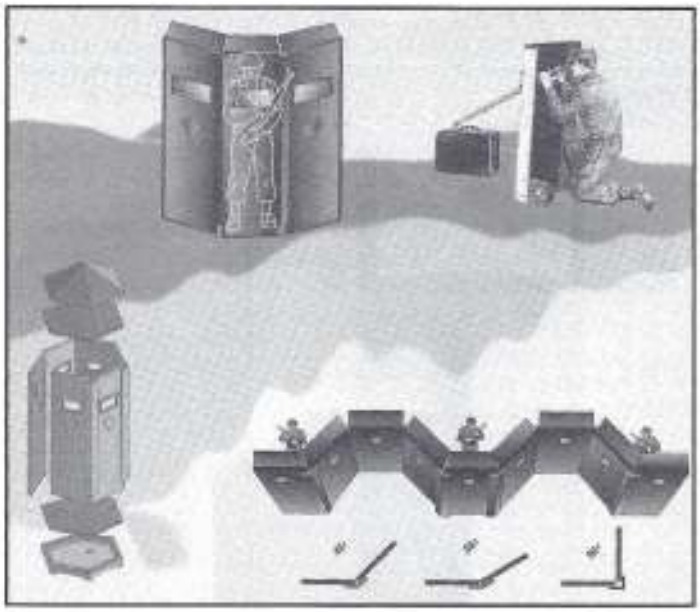
Description
ETEM, founded in 1980, manufactures a wide range of security products, including bulletproof vests, watchtowers, automatic barriers, metal detectors, perimeter protection systems, prefabricated steel and concrete shelters, armour-plated doors and bulletproof glass.

Of particular interest is the system of modular shields which can be used individually to protect, for example, an EOD operator or sentry, or linked together to form a protective barrier, compound or pillbox. A similar system is used to provide bulletproof modular field fortifications, which can be used as protected logistic shelters, firing pits, breastworks or several other forms of defensive structure.

Full details and specifications can be obtained from the company on request.

Status
In service in Israel. Customers include the Italian MoD, Italian Ministry of Justice, Italian Police Force, NATO and other organisations.

Contractor
ETEM Srl.



ETEM modular shield system
0516433

Russian Federation

Explosives container

Description
This explosives container assists in the isolation of letters, parcels and printed matter which are suspected of containing an explosive device. There is complete protection of personnel and surroundings from the destructive effect of random blast with complete gas impermeability in case of a random blast in the chamber. The container comes complete with folding handles and wheels to enable rapid transport and carriage.

Specifications
Max charge mass: 0.3 kg
Max dimensions of the parcels/items to be transported:
355 × 245 × 12.5 mm
Container dimensions (handles folded): 670 × 660 × 470 mm
Weight: 75 kg

Status
In production and in service in Russia.

Contractor
Institute of Applied Physics.

Explosives container
0023361

Sweden

Explosion Containment Vessel (ECV)

Description
The Explosion Containment Vessel (ECV) series of vessels is designed either for mobile transport and containment or for stationary use, such as storage and for experiments. The ECVs are always customised but are usually gas-tight for use with explosives, toxic materials or a combination of both. The containment (gas-tight) capacity ranges from 1 to 25 kg of TNT equivalent repeated detonations. ECVs can be equipped with windows which enable ultra high-speed filming of detonations as well as pressure recording.

Stationary ECVs offered are often used for the testing of explosives, munitions and munition components. The first chamber delivered by Dynasafe for this use in 1981 is still in operation.

Different mobile ECVs are in operation, being used to transport explosives and munitions. Several chambers delivered have been used for the safe transport of chemical munitions, usually old, recovered munitions. Clients have included organisations in China, Germany, Japan, Sweden and the United States.

The various customisations include: remote-controlled loading and unloading; fragment protection shields; decontamination equipment; gas sampling and off-gas cleaning; internal heating device for destruction; and a variety of vehicles and trailers for mounting.

A Dynasafe ECV (Dynasafe)
1154139

Status
Available.

Contractor
Dynasafe AB.

GEC chambers

Description
Dynasafe's series of GEC chambers is designed for the safe storage and transport of explosives, toxic materials or a combination of both. As with all Dynasafe's containment products, the GECs are gas-tight and allow for the sampling of gases before they are safely released following detonation.

The GECs are designed to withstand repetitive detonations up to the maximum amount of explosive specified, the various GECs being able to contain the effects of detonating explosive devices ranging from 50 grams to 2,500 grams of TNT equivalent. GEC models 3 – 6 can be equipped with a valve for release of overpressure; all models have an overpressure bleed off screw.

GEC Chamber (Dynasafe)
1166482

GEC Chamber (Dynasafe)
1166483

The GECs are available in different standard designs or can be tailored to meet the specific demands of clients. Some of the units delivered today are used for the transport of explosive devices by air. They are designed to allow for fast loading/unloading, offer a high explosive resistance but feature low weight and flexible design.

Status
In production and in service.

Contractor
Dynasafe AB.

MBDC chambers

Description
The MBDC series of chambers protect against high-speed fragments and blast wave in a horizontal direction. The units are recommended for use only outdoors in relatively open areas. They offer a high level of protection from a large explosive detonation, the level being dependent upon the particular customer's demands.

In its basic design, the MBDC comes with Dynasafe's Integrated Loading Crane (ILC). This allows the MBDC to be loaded from a safe distance. It can also be upgraded with the addition of the Dynasafe Loading System, which allows the removal of the suspect item from where it was found, bringing it to the chamber and finally loading it into the unit. In the basic design, it is built on a double-axis trailer that can be towed by an SUV or similar vehicle.

Status
Available.

Contractor
Dynasafe AB.

Dynasafe MBDC 4 (Dynasafe) 1326674

MECVxL vessels

Description

The MECVxL series of vessels is designed for the safe containment and removal of suspect items, possibly containing explosives, toxic or radiological materials or combinations of these. As with all Dynasafe containment products, the MECVxL is gas-tight and offers the possibility of sampling and cleaning gases before they are safely released and to decontaminate the chamber prior to opening. The MECVxL is designed to withstand repeated detonations up to the maximum amount of explosives specified for the specific model.

The MECVxL's operating sequence – opening, locking and closing – is performed automatically by the operator from a safe distance. The unit can also be used in conjunction with a remote-controlled robot. The MECVxL can be mounted as specified by the client.

The MECVxL basic design is used at locations such as airports but other models include the MECV5L-A series and the MECVxL-B series. Designs allow for modifications to mounting, volume, loading and capacity.

Status

In production and in service.

Contractor

Dynasafe AB.

An MECV5L-B3 mobile containment vessel (Dynasafe) 1154135

Portable Explosion Containment Vessel (PCV)

Description

The PCV series of gas-tight containment vessels are designed for the safe containment and removal of suspected items which might contain explosives, toxic materials or a combination of both. As with all Dynasafe containment products, the PCV allows for gases to be sampled before they are safely released, via a valve system, following detonation. Made from high strength steel, the PCV is designed to withstand repeated detonations up to 250 g TNT equivalent.

There are five different PCVs offered to meet the various demands in respect to loading capacity and explosive containment capacity. The standard PCV series provides loading capacities for objects from 400 × 200 × 300 mm up to 1,200 × 650 × 800 mm but the vessel can also be tailored to meet the demands of the client.

Each vessel is equipped with a loading box or loading tray, depending on the model. The PCV1 is mounted on a four-wheel cart for easy removal and both horizontal and vertical positioning. Loading and unloading is performed manually. The larger PCVs are mounted on steel, wheeled frames that are manoeuvred automatically from a distance. The S version, PCV-S, is differently designed but is also available in five different sizes and is always manoeuvred manually.

Status

In production and in service.

Contractor

Dynasafe AB.

Dynasafe PCV 1 (Dynasafe) 0673717

Dynasafe PCV 2
(Dynasafe)
1326678

Portable Explosion Suppression Vessel (PSV) vessels

Description

The PSV series of vessels is designed to suppress the effects of an item, such as a letter bomb, should it detonate while EOD experts are on their way or during its removal to a safer location. As with all Dynasafe suppression products, the PSV provides protection against fragments and also suppresses the effects of a blast wave.

The PSV is manufactured from high strength steel and can withstand one detonation of 250 g TNT equivalent.

The PSVs are offered in various sizes to cater for the size of the object to be placed within the vessel. The PSVs can also be tailored to meet the specific demands of the customer. They are easy to use, being opened simply by turning an outer cylinder through 180° and closed by turning it back.

Dynasafe PSV (Dynasafe) 0673718

The vessels are mounted on wheeled carts or wheeled frames, which in combination with their low weight allow them to be used inside buildings. Larger versions of the PSV can also be equipped with Dynasafe's Integrated Drive Unit (IDU), to further ease their movement. The smaller PSVs are mounted on carts that allow them to be positioned and transported in both the horizontal and vertical position.

Status
In service.

Contractor
Dynasafe AB.

Switzerland

MobilFORT protection system

Description
MobilFORT is a modular, mobile protection screen developed for the protection of people, objects and goods in the military, security and civil sectors. The screens are constructed with a frame of chromium steel and can offer several levels of protection against direct fire, explosions and fragmentation from mines or grenades.

The system is quick to handle, taking two people 15 minutes to build a 10 m length. MobilFORT is easily transported on pallets.

Status
In production.

Contractor
Tissu Rothirst AG.

United Kingdom

Anti-personnel mine protective blanket

Description
This anti-personnel mine protective blanket is manufactured from high quality aramid bullet-resistant material and is designed for EOD operators to place over a suspect anti-personnel mine to contain the effects of blast and fragments.

The 1 × 1 m blanket is provided complete with carrying handles and a carrying bag. One side of the blanket is coloured fluorescent orange and the other side is khaki/brown. The bright orange colour allows clear identification of the location of a suspect device.

In addition to its use during mine clearance operations, the blanket can be used for protection against handguns, and flying fragments from small grenades and mortar rounds.

Specifications
Dimensions: 1 × 1 m
Weight: 4 kg
Protection level: NIJ Level 2A. V 50 425 m/s fragment 17 grain
NATO stock number: 1385-99-219-5446

Status
In production.

Anti-personnel mine bomb blanket (SDMS Security Products Ltd) 0074358

Contractor
SDMS Security Products Limited.

Bomb suppression blanket and safety circle

Description
The SDMS bomb suppression blanket and safety circle is intended to provide both the EOD operator and non-skilled personnel with lightweight, protective and easily portable protection from fragments and shrapnel. The blanket and safety circle are designed to contain most low-velocity particles on detonation.

Use of the blanket and circle eliminates direct contact with a suspect device and provides a safe environment for its disposal; the safety circle is placed around the suspect device and then the bomb blanket is carefully placed over the safety circle. Should the device explode, the safety circle can help to direct the force of the bomb s explosion upwards. The bomb blanket then flexes and contains most of the bomb fragments. Two or more safety circles can be used together to contain larger devices.

The blanket has four heavy-duty nylon webbing handling straps which allow it to be safely placed over the suspect device. A range of blanket sizes is available on request and the equipment folds up into a compact, easily carried bag.

Different sizes and protection levels can be made to order.

Specifications
Weight: 13.5 kg (approximate)
Dimensions: 1.5 × 2.0 m
Protection level: V50, 17 grain steel fragment at 400 m/s
NATO stock number: 4240-99-811-9508

Bomb suppression blanket and safety circle (SDMS Security Products Ltd) 1334746

Status
Available. In service with armed forces and police units, as well as government bodies and private companies.

Contractor
SDMS Security Products Limited.

Bomb suppression blanket Model BPS – V50 – 500

Description

The lightweight BPS – V50 – 500 bomb blanket and stand-off ring are designed to minimise and contain the products of a 0.5 kg explosive charge. A bomb blanket cannot prevent damage being sustained by a building, the people in it and/or the equipment contained in the surrounding area; it can only minimise such damage.

A polyurethane-coated nylon fabric is used to protect the ballistic fabric from the ingress of moisture, in both the bomb blanket and stand-off ring. The outer cover is constructed from heavy-duty ballistic nylon.

The extra long handling straps permit the bomb blanket to be placed over the suspect item without personnel having to stand directly over the suspect explosive device. The flexibility of the blanket permits it to drape over the suspect item to ensure maximum protection. At 430 mm, the height of the stand-off ring is designed to permit the complete accommodation of a standard briefcase and to give maximum protection. A 200 mm high ring is also available.

When not in use, the bomb blanket and stand-off ring are stored in a waterproof bag that is fitted with handles and a carrying strap for ease of deployment.

Although typical specifications are given here, a range of other sizes, styles, colours and protection levels is also available.

Specifications

Deployed: ±5 cm (length + width)
Blanket: 1.20 × 1 m

Bomb suppression blanket 0023363

Stand-off ring: 1.85 × 0.43 m or 1.25 × 0.2 m
V_{50}: 17 g fragment at 500 m/s
Weight (blanket only): 5.75 kg

Status

In production and service in the UK.

Contractor

Ballistic Protection Systems (Europe), a Division of Bennett Safetywear Limited.

1.4S DCU 500 Series (Detonator Containment Unit)

Development

Aigis Blast Protection Limited manufactures a range of protection systems employing its patented Technology for Attenuating Blast-Related Energy (TABRE™). Included in the range are the Detonator Containment Units, designed and tested for the safe isolation and carriage of up to 18 detonators.

Description

The DCU 500 series allows easy transfer of detonators to and from the units, it is available in alternative formats to suit most standard types of detonator. It comes in standard NATO ammunition box dimensions.

The unit also provides over 7 minutes protection before the first detonator initiates in a fuel fire.

The DCU 500 series is fully certified with UN packaging number and UN Hazard Classification 1.4S and contains blast and secondary fragments protecting personnel when carried by hand. The unit prevents sympathetic detonation and enables electric and non-electric detonators and explosives to be stored and transported in the same vehicle. The DCU 500 series comes in the following variants:

Variants

DCU 500
The DCU 500 has 1 chamber to store detonators from IEDs for forensics.

DCU 510
The DCU 510 is available with 8 Chambers to accommodate detonators with extra long wires.

DCU 520
The DCU 520 has 18 chambers.

Other variants can be manufactured to requirements.

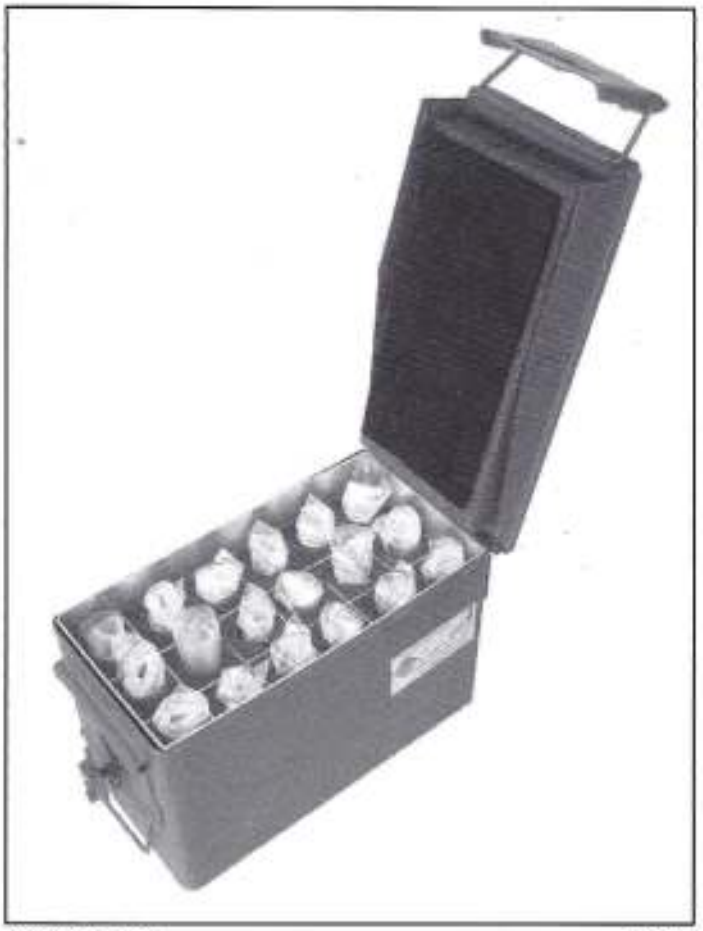
Specifications

Total weight: 5.8 kg (12.8 lbs)
Exterior envelope

width:	155 mm (6 in)
length:	300 mm (12 in)
height:	185 mm (7 in)

Interior envelope

1 chamber	85 mm (w), 220 mm (l), 80 mm (h) (3 × 9 × 3 in)
8 chambers	each chamber measuring 35 mm (diameter), 100 mm (d) (1 × 4 in)
18 chambers	each chamber measuring 25 mm (diameter), 75 mm (d) (1 × 3 in)



DCU 520 (Aigis) 1375322

Status

Available. The DCUs have been used by de-mining companies, EOD teams in the UK (army, navy, RAF) and NATO in Iraq, Afghanistan and Bosnia.

Contractor

Aigis Blast Protection Limited.

1.4S Explosives Storage and Transport Units

Description

Aigis explosive transport units are designed for the transport and static storage of explosives. Each tray can transport up to 1.5 kg of explosive and have UN Hazard Classification 1.4S for the transport of primed grenades, about 20 of which can fit into each tray. The unit provides 23 minutes of protection before the first grenade initiates in a fuel fire. Also suitable for explosives samples. The maximum charge size per chamber is 75 kg TNT equivalent. Multiple trays allow drawers to slide

open, although they are also able to be locked and sealed. They are easy to fit into and remove from vehicles and are available in two sizes of chamber. Preventing sympathetic detonation, they are designed for military, police and Gendarme forces.

Specifications
Dimensions
External: 640 × 500 × 260 mm
Internal (two sizes): 70 × 100 mm and 70 × 180 mm
Weight per unit: 140 kg (approximate)

Status
In service.

Contractor
Aigis Blast Protection Limited.

Safety containers

Development
AML UK Limited manufactures specialist blast containers to meet the needs of post rooms and public/commercial areas.

Description
Post room containers are designed to help mitigate the effects of blast from explosive devices by channeling blast more safely and suppressing primary fragmentation, thereby reducing the risk of serious injury.

For public and commercial areas a range of specialist litter bins, in a variety of styles, has been tested to the requirements of the UK Home Office to meet the anticipated level of threat. In the event of an explosion, the bin is designed to direct the blast away from the ground. The bin material will then shred, absorbing blast and fragmentation as it does so. Non blast-resistant versions of each style are also available to enable protection to be offered in high-risk areas, while maintaining a consistent image. The bomb blast bins are constructed from a composite woven material to withstand blast and fragments from Improved Explosive Devices (IED) containing up to 16 oz (500 g) of PE4. The units have a removable inner bag which are designed to hold a suspect device in the upright position to allow x-ray inspection whilst in the container.

Status
In production.

Contractor
AML UK Limited.

Safeway bomb containment trailer system

Description
The Safeway bomb containment trailer system was developed to allow relatively inexperienced operators to remove a suspect device to a location where it can be examined or destroyed in safety. The system can contain an improvised explosive device (IED) measuring up to 600 mm by 800 mm by 600 mm in size and with an explosive equivalent to 4 kg of TNT. It can be used with a minimal amount of training.

The Safeway system consists of a specially designed bomb container mounted on a four-wheeled trailer, which can easily be towed. The container is made from two layers of high-strength, high-impact 40 mm ballistic steel. The chamber space between the inner steel 'tube' and the outer steel wall contains sand which, together with the strengthened ballistic steel, helps absorb the effects of blast, enabling the container to be used repeatedly. The container's thermal and pressure-tolerant design also provides high explosion suppression capability; in the event of an accidental detonation, the tubular design pushes the blast effect upwards, rather than sideways, minimising damage to the towing vehicle trailer body and surrounding area.

A suspect device can be picked up with the aid of a hand-portable telescopic manipulator, which is provided with the Safeway system. The operator places the device on the back of the trailer and the rotating hydraulic lifting arm is remotely operated to raise the package and place it within the container. Shock absorbers help to protect the container from any sudden movement while under tow and, once a safe destination is reached, the suspect device is unloaded by reversing the above process.

Specifications
Trailer:
length: 3.67 m
width: 1.9 m
Outer container:
height: 1 m
width: 1 m

Safeway bomb container trailer system (SDMS Security Products Ltd) 1334747

Inner container:
height: 1 m
width: 0.64 m
Height: 1.42 m
Steel thickness: 40 mm
Weight: 900 kg
Protective level: 4 kg of TNT
NATO stock number: NSN1385-99-331-1632

Status
Available.

Contractor
SDMS Security Products Limited.

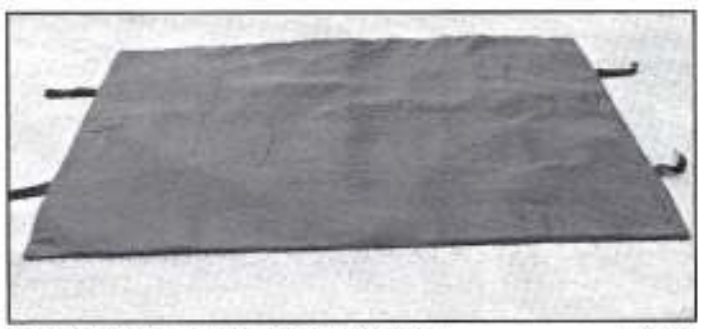
SDMS Ballistic blanket

Description
The SDMS ballistic blanket provides a portable, flexible, lightweight means of ballistic protection against fragmentation and ballistics. Manufactured from multiple layers of Kevlar, the blanket can be used effectively as a bomb suppression blanket. It can also be used to cover windows, doors, ceilings or other openings, permitting safe passage during a hostile situation.

The blanket folds easily for storage and is provided with heavy-duty webbing loop handles for storage and suspension. A range of non-standard sizes is available on request.

Specifications
Standard size: 2 × 1 m

Status
Available.



Ballistic Blanket (SDMS Security Products Ltd) 1334750

Contractor
SDMS Security Products Limited.

Split Hex Bin

Description
The Split Hex Bin Isolator facilitates placement of the isolation system in areas where access to the device is difficult or restricted for example under a table or adjacent to a wall.

In testing, the Hex bin will arrest fragmentation arising from devices up to 10 kg Net Explosive Quantity (NEQ) and reduce blast overpressures by 70 per cent.

Specifications
Height: up to 3 m
Base width: up to 2 m
Weight: (600 mm size) – 10 kg
Water content: (600 mm size) – 250 litres

Status
Available and in production.

Contractor
Cintec International Limited.

Split Hex Bin (Cintec International Limited) 1334744

Suspect postal bomb container

Description
The suspect postal bomb container has been designed as a suitable container for the safe isolation of a suspected explosive device. It is made of glass reinforced plastic material with additional fire-resistant resin and is large enough to accommodate a briefcase. The blast is directed upwards and an explosive device of up to 0.5 kg can be absorbed.

The container is designed to keep the suspect article in an upright position and its internally fitted net still allows EOD operators to remove, X-ray or undertake a controlled explosion of the item.

It is supplied in matt black and has a service life of at least 10 years.

Specifications
Height: 900 mm
Outer diameter: 493 mm
Thickness: 18/19 mm
Weight: 50 kg
Protection: V50 480 m/s

Status
Available.

Contractor
SDMS Security Products Limited.

Suspect Postal Bomb Container (SDMS Security Products Ltd) 1334748

Threat Containment Unit IU 1000 series

Description
Aigis threat containment units are simple, intrinsically vented steel boxes lined with TABRE™ blast attenuation material. Each unit has a fail-safe, three-catch, positive closing system with no concealed mechanism, allowing an immediate visual assessment that the unit is closed correctly. The units have been sized to fit under a standard work surface for storage and to go through standard doorways. They have the capacity for a wide variety of packages, including calendar/drawing tubes and are fitted with rubber-wheeled castors making them easy to move.

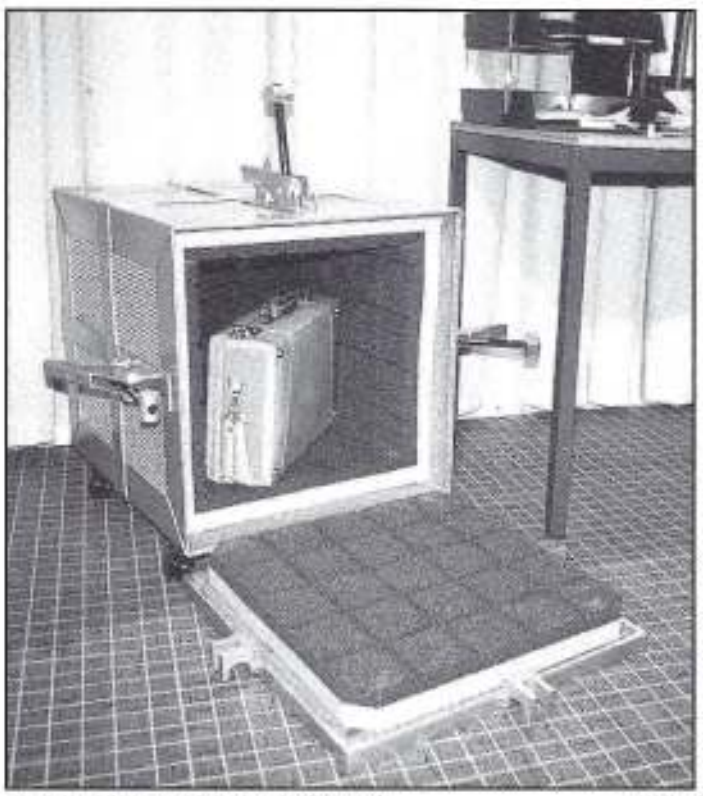
The product range includes:

- Threat Containment Unit IU 1000 – designed for the safe containment of postal bombs by containing both the blast and fragmentation whilst preserving forensic evidence;
- Threat Containment Unit IU 1010 – a top-loading version of the 1000, this unit is designed for quickly isolating confiscated suspect items from a search operation and for mail sorting and quarantine; and
- Threat Containment Unit IU 1020 – fitted with internal shelves and a physical security locking system, this unit can be used for the storage of explosive samples in laboratories and for the transportation of training samples for dog search teams.

Specifications
Dimensions
external: 700 × 670 × 705 mm
internal: 475 × 380 × 380 mm
Weight: 120 kg (approximate)

Status
In service.

Contractor
Aigis Blast Protection Ltd.



Threat Containment Unit IU 1000 (Aigis) 0516576

Threat Containment Unit IU 1200

Description
The Aigis Threat Containment Unit IU 1200 is fitted with Aigis TABRE™ blast mitigation material and is designed for the immediate containment and rapid removal of IEDs and suspect hand baggage. Features include an easy swing open lid by robot or hook and line, full face opening for easy internal access and single action locking for prompt closure. With no hydraulics, pneumatics or electrics, the IU 1200 is easy and safe to operate. It has a towing bracket suitable for its own towing handle and hook and line. It is also mobile by robot, tractor or manually. The IU 1200 is fully compatible with EOD remote equipment.

Other Bomb Containment units in the range include the IU 1000 series for a smaller explosive charge such as letter bombs and the 2000 unit used for suspect hold baggage.

Specifications
Weight: 320 kg

Status
In service.

Contractor
AIGIS Blast Protection Ltd.

Threat Containment Unit IU 2000

Description
The Aigis Threat Containment Unit IU 2000 is used for the immediate containment of an explosive threat from suspect hold baggage. Features include single locking handle for easy opening and closing by robot or hook and line, full face opening and large internal space which accommodates over-sized baggage in any orientation and a self centring shelf adjustable in height and slope to meet the conveyor belt, thus improving the speed of containment. Highly mobile, the IU 2000 comes either on a standard airport trailer or a road-going trailer to suit requirements. The unit is fully compatible with EOD remote equipment.

Other Bomb Containment units in the range include the IU 1000 series for letter bombs and the IU 1200 unit for suspect hand baggage. The range is fitted with Aigis' proprietary TABRE™ blast attenuation material.

Status
In service.

Contractor
AIGIS Blast Protection Ltd.

Universal Containment System/UCS (AE)

Description
The Universal Containment System (UCS), first developed by Vanguard Response Systems of Canada, was designed for use by first responders and special forces against improvised explosive device/NBC threats and unexploded ordnance. It comprises a 4-, 6- or 8-panel system within the form of a tent that is placed over the suspect device. The enclosure is then filled with a blast suppressing foam and the whole structure is covered in a fitted ballistic blanket enclosure.

A decontaminating blast suppression foam CASCAD™, which is primarily designed to neutralise biological and chemical warfare agents, is available for use against explosive bio-chemical dispersal devices.

A 300 gallon water reservoir and portable water pump are also available.

The UCS Advanced Enclosure, or UCS (AE), has been developed by Allen-Vanguard to enhance the containment, mitigation and decontamination capabilities of the UCS. The AE is specifically designed to protect against devices placed along side walls, corners or near poles and columns. The AE fabrication consists of three layers of ballistic felt, sandwiched between an inner and outer water-resistant nylon shell. The cover is similarly fabricated with three layers of ballistic felt enclosed in an inner and outer water-resistant nylon shell. The Air Foam Dolly System (AFDS) is one of the primary delivery units used to fill the AE with foam; depending on the configuration, the AE can be filled in less than 20 seconds.

Status
In production and service with bomb squads over the world.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

Allen-Vanguard's UCS (AE) (Allen-Vanguard) 1195367

Universal Containment System with optional water reservoir and pump (Vanguard Response) 0573667

Vorsphere™

Development
Airolusion, until recently a research and development company, have developed the Vorsphere™ range of blast containment vessels to mitigate the blast and fragmentation from Improvised Explosive Devices (IED), Explosive Ordnance Disposal (EOD) and anti-personnel (AP) and anti-tank (AT) mines, motors and explosive remnants of war (ERW). Successfully tested by the Home Office Scientific Development Branch (HOSDB) in 2003 with 2 kg and 4 kg in the same unit. Airolusion have undertaken proof of purpose testing and are launching the product to market.

Description
The Vorsphere™ range is designed to be a portable and reusable receptacle that will mitigate explosive devices without causing harm or damage to the environment or personnel and without allowing any fragmentation. The unit can also ensure that there is no contamination by having no trace of the device remain. The apparatus does not require to be secured

Specifications

Variant	Height × Diameter (mm)	Height × Diameter (inches)	Material	Containment specification
Vorsphere™ Vantage	720 × 700	28.3 × 27.5	steel	1.4–2 kg C4 or PE4
Vorsphere™ Valour	1,020 × 1,000	40 × 39.3	steel	2–4 kg C4 or PE4
Vorsphere™ Venturer	1,020 × 1,000	40 × 39.3	steel	3–5 kg C4 or PE4
Vorsphere™ Vanquish	1,200 × 1,180	47.2 × 46.4	steel	4–6 kg C4 or PE4
Vorsphere™ Victory	1,520 × 1,500	59.8 × 5.9	steel	6–8 kg C4 or PE4

to the ground or transport unit. The units can be easily transported and easily manoeuvred into any location.

Airolusion can readily manufacture bespoke specification units to order which can contain a wide range of devices or be designed for a specific situation or environment.

Status
The Vorsphere™ range has been available since July 2008. Production available on request.

Contractor
Airolusion Ltd.

Vorsphere™ blast containment vessel (Airolusion Ltd)
1296288

Waterwall EOD Blast Bin

Description
Designed specifically to meet the requirements of the British Army Bomb Squads, the EOD Blast Bin uses water to mitigate the blast and fragmentation effects of unexploded ordnance (UXO).

Being able to be transported empty, the Blast Bin provides an easily deployable blast containment capability. Once inflated the bin provides all round containment, surrounding a device on all sides and above. It is claimed by the manufacturer to be able to mitigate the effects of a device up to 10 kg Net Explosive Quantity. A removable front panel allows access to the device whilst leaving the bin in place. This panel can also be deployed as a stand-alone blast barrier.

Specifications
Height: 1.0 m
Width (each panel): 1.2 m
Containment area: 600 × 600 × 600 mm
Weight:
empty: 20 kg
full of water: 1,200 kg
Filling time (single panel): 10 min

Status
In production. In service with the British Army.

Waterwall EOD Blast Bin (Cintec International Limited) 1334740

Contractor
Cintec International Limited.

Waterwall Hex Bin Isolator

Description
The Hex Bin Isolator is designed to isolate possible danger from potential explosive devices. It is ideally suited for use in locations such as postal sorting offices, transportation centres and shopping malls as well as commercial premises and medical facilities. The Hex Bin Isolator can be deployed in a variety of ways and, when there is a risk of explosive devices detonating prematurely, the bin can be deployed robotically. Made from PVC double wall fabric, the hexagonal shaped isolator provides an all round blast mitigation capability for devices up to 20 kg Net Explosive Quantity (NEQ).

Hex Bin Isolator (Cintec International Limited)
1334738

Filled with any type of water, the walls of the isolator significantly reduces the velocity of fragments produced by a blast as well as reducing blast pressures by as much as 95 percent. The isolators can be made in a variety of sizes to suit user requirements.

Specifications
Height: up to 3.0 m
Base width: up to 2.0 m
Weight (600 mm size): 10 kg
Water content (600 mm size): 250 litres

Status
In production.

Contractor
Cintec International Limited.

Maxi and Mini Hex Bin Isolators
(Cintec International Limited)
1334739

United States

Basic bomb handling system

Description
The Protection Development International Corporation basic bomb handling system provides a complete method for moving a suspect explosive device to a safe area, while reducing the risk to bomb handlers, property and public safety. The system includes the following items of equipment:

Personal protective equipment
The recommended personal body protection used during a handling operation comprises ballistic body armour, helmets and body shields for a two-person team. A bomb-handling sled is available to provide additional protection.

Bomb baskets
Two laminated ballistic glass fibre bomb baskets are provided: one with a closed bottom, the other open. These baskets are designed to vent the explosive forces upwards, while containing horizontal fragmentation in the basket wall.

Remote handling equipment
To enable the suspect device to be moved remotely a drawstring net, lifting bridle, pulley-clamps, and 30 and 60 m polypropylene ropes are provided. The lifting bridle comprises four ropes woven into a common lifting ring and each rope is fitted with a snap-lock hook. The bridle is attached to the bomb basket and used to manipulate the basket or to lift it into the bomb transport trailer.

Bomb transport trailer
The trailer provides a means of moving the suspect device to a safe area by road. The trailer body is made from moulded glass fibre, with compartments to stow the bomb handling equipment. The trailer frame is made from welded steel channel and the four wheels are independently suspended with their own spring and axle assembly allowing the trailer to have a clear area under the bomb trailer basket. The trailer basket is made from 40 laminations of non-fragmenting ballistic glass fibre, suspended between four glass fibre supports by nylon webbing. The trailer is equipped with a lifting device that enables a bomb basket to be loaded from a distance of up to 30 m.

Specifications
Body armour
Weight: 1.36 kg (3 lb)

Helmet
Weight (with face shield): 2.72 kg (6 lb)

Body shield
Weight: 9 kg (20 lb)
Dimensions: 0.6 × 0.9 m (24 × 36 in) (approximately)

Closed bottom bomb basket
Diameter: 0.69 m (27 in)
Height: 0.6 m (24 in)
Weight: 43 kg (95 lb) (approximately)

Open bottom bomb basket
Diameter: 0.69 m (27 in)
Height: 0.53 m (21 in)
Weight: 34 kg (75 lb) (approximately)

Bomb transport trailer
Weight: 680 kg (1500 lb) (approximately)
Height (max): 1.6 m (63 in)
Length: 3.76 m (148 in)
Width: 1.88 m (74 in)

Status
In production and in use.

Contractor
Protection Development International Corporation.

Disruptor ring

Description
PDIC's disruptor ring is compatible with Pan, Neutrex or Royal Arms disruptors and is designed to eliminate the need to carry sandbags or rig other protective methods prior to disrupting a suspicious object.

Two sizes of ring are available, large and small. The ring is placed over the suspect object with the disruptor slot located in an accessible area. The disruptor is used either through the slot, or over the top, of the ring. The ring is designed to vent any explosion upwards thereby protecting EOD technicians and the surrounding area from horizontal blast and frag.

The ring should be replaced if anything more than superficial interior damage is visible.

Specifications

	Large Ring	Small Ring
Weight:	27.2 kg	16.3 kg
Diameter:	698.5 mm	546.1 mm
Height:	558.5 mm	431.8 mm

Status
In production.

Contractor
Protection Development International Corporation.

Frag bag

Development
In the late 1990s, LAST Armor (a division of Foster-Miller Inc) developed a man-portable, low cost, bomb containment system named 'Frag bag' which has a soft-sided construction and is compatible with Explosive Ordnance Disposal (EOD) robots. Designed for use in public safety, private security, postal service and corporate mail room functions.

Description
There are no metal parts which makes the bag safe for x-ray. The Frag bag is fitted with a number of 'grab points' so that it can be opened, loaded, closed and transported with a bomb stick or remote manipulator. This bag is designed to dissipate and deflect overmatch blast up and away from personnel and the public while capturing fragments for forensic examination. The low-cost bag fits easily in the boot of a police car and has been successfully tested by Los Alamos National Laboratory and New Mexico State Police Bomb Technicians against 2 × 8 in pipe-type devices. The Frag bag has also been successfully tested against 2 ounces of C4.

Frag Bag (LAST Armor) 1334742

Frag Bag (LAST Armor) 1334743

Specifications
Height: 304 mm
Width: 330 mm
Length: 560 mm
Weight: less than 11.3 kg

Status
In production and widespread service.

Contractor
LAST Armor (a division of Foster-Miller).

Letter Bomb Mini-Basket

Description
This mini-basket isolates suspect letters until trained explosive-handling personnel arrive. It is small enough to be placed in a multitude of locations and no special training is required before use. The Mini-Basket's cylindrical inner basket construction is designed to direct energy and force upward, with minimal overpressures. The interior is composed of laminated non-fragmenting ballistic coving with a suspended nylon net at mid-centre.

Specifications
Weight: 9.06 kg (20 lb)
Outside dimensions: 330 × 330 × 387 mm (13 × 13 × 15.3 in)
Interior: black inner basket
Exterior: black, wood grain, or as available/current production

Status
In production and in service.

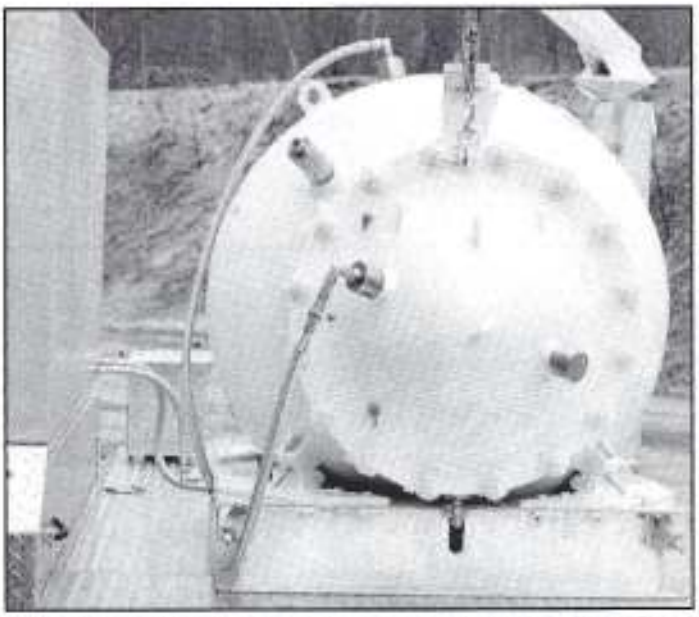
Contractor
Protection Development International Corporation.

Model 42-GT Gas-Tight Total Containment Bomb Vessel (TCV) for chemical and biological IEDs

Development
In response to the growing threat of Improvised Explosive Devices (IEDs) combined with either chemical or biological agents, NABCO has modified its Model 42TCV (see separate entry) so that it can operate as a gas-tight system. The Model 42-GT can safely contain all of the gases generated from a detonation of up to 1.36 kg of C-4 or equivalent. It is also rated for up to 4.5 kg of C-4 in the controlled venting mode.

Description
The modified vessel can be used for both conventional and chem-bio IEDs. In the event that a chemical or biological agent is suspected, the

Model 42 Gas-Tight Total Containment Vessel with Self-Closing upgrade (NABCO Inc) 1290157



TCV with treatment hoses and secondary door in place (NABCO Inc) 0074366

Control panel enclosure for treatment valves and operator controls (NABCO Inc) 0074367

device can be disrupted inside the TCV and the entire vessel can then be decontaminated and flushed. Air samples from the interior can be taken to determine the appropriate treatment and to verify that the decontamination process was successful. The telescopic internal basket assembly allows the unit to be used in conjunction with EOD remotely operated vehicles, virtually eliminating human exposure during the loading process.

The Model 42-GT, as with all of NABCO's TCV range, can be upgraded to feature a self-closing mechanism, comprising an on-board 8 KW generator to power an automatic hydraulic door closure yoke, which provides a faster and relatively safer method of closing the vessel while in operation. An on-board 12-volt back-up power system is also available to operate the door yoke in the event of a generator failure. The TCV can also be optionally equipped with a remote closure system that moves the locking mechanism into place and tightly secures it. This system is operated with a 2-axis, variable speed hand-held joy stick connected to 5 m of cable.

Modifications specific to the GT include a secondary airtight door installed onto the TCV. Existing vent holes are sealed and replaced with a drain post; purge port for flooding with decontamination material; sample post for testing internal atmosphere and an electrical interface to enable a charge to be detonated inside the TCV. The gas-tight modifications can be retrofitted onto existing Model 42 TCVs without affecting the warranty and older gas-tight models can also be upgraded to the new BioChem-rated performance level, which allows the TCV to contain biological or chemical hazards up to the TCV's maximum rated explosive charge.

Specifications
Operational temperature range: –35.5 to +48.9°C
TCV weight: 1,815 kg
Access opening: 57 cm

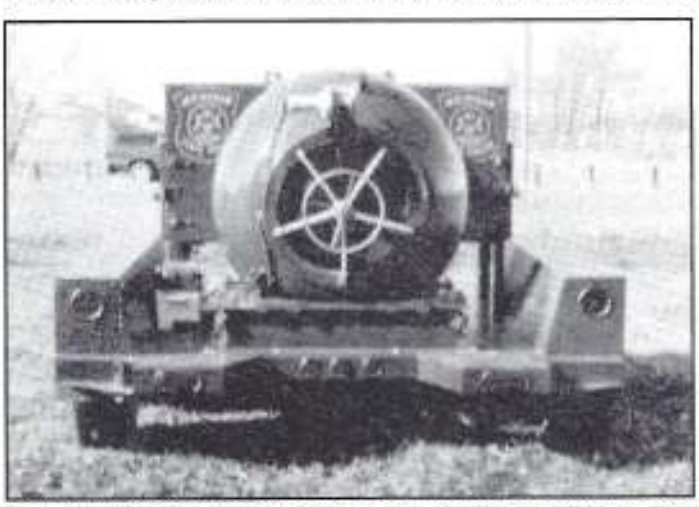
Status
In production.

Contractor
NABCO Inc.

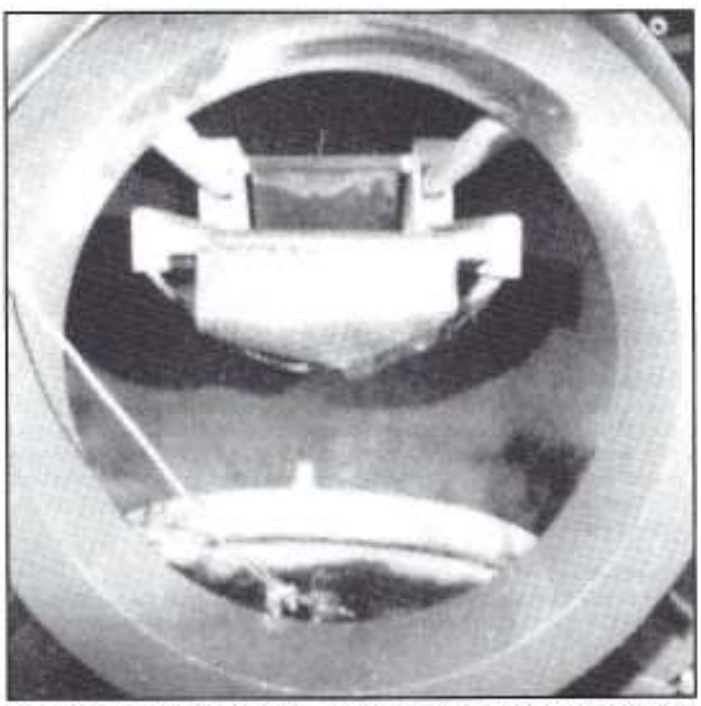
Model 42 Total Containment Bomb Disposal Vessel

Development
The NABCO Model 42 Total Containment Bomb Disposal Vessel (TCV) was developed for the US Government and first used during the 1984 Los Angeles Olympics.

Description
The Model 42 container is made from high-strength, high-impact steel of 38 mm thickness. The suspect explosive device is contained in a disposable basket which is loaded into the unit through a 550 mm opening. The telescopic internal basket assembly allows the unit to be used in conjunction with EOD remotely operated vehicles, virtually eliminating human exposure during the loading process. The vessel is provided with an I-beam suspension cradle to allow immediate radial expansion and a fragment-attenuation tube for loading devices such as pipe bombs, mortars and grenades.



The Model 42 Total Containment Vessel in use with the Michigan State Police (NABCO Inc) 0074363



The Model 42 basket assembly, designed for use with robotic devices, greatly reduces human exposure (NABCO Inc) 0074364

Each container is tested with an explosive force of 4.5 kg of Composition 4 and is capable of controlling the overpressure caused by the explosion so that it will not exceed 27.5 kPa (4 lb/sq in) within a 1.5 m diameter of the sphere's surface.

The unit may be furnished on a trailer assembly or prepared for installation on any large vehicle body. No damage will be caused to the towing vehicle or trailer body in the event of accidental detonation while in transport. The disposal unit may also be installed permanently for use in high-security areas or for testing purposes. Provision can also be made for various shoreline operations.

Both the Model 42 TCV and the larger Model 64 (see separate entry) can be upgraded to feature a self-closing mechanism, comprising an on-board 8 KW generator to power an automatic hydraulic door closure yoke, which provides a faster and relatively safer method of closing the vessel while in operation. An on-board 12-volt back-up power system to operate the door yoke in the event of a generator failure is also available. The TCV can also be optionally equipped with a remote closure system that moves the locking mechanism into place and tightly secures it. This system is operated with a 2-axis, variable speed hand-held joy stick connected to 5 m of cable.

Specifications

The figures in brackets indicate a variation between the standard TCV and the self-closing upgrade where applicable
Internal container diameter: 1.07 m
Weight: 1,600 (1,587) kg
Height: 1.25 m
Width: 1.14 m
Length: 1.3 m
Access opening: 550 (698) mm
Explosive basket: 41 × 53 × 15 cm
Operational temperature range: –35.5 to +48.8°C

NABCO Model 42 self-closing TCV (NABCO Inc) 1298768

Status

In production. In use throughout the world including US military, US security agencies, US state, county and city EOD units.

Contractor

NABCO Inc.

Model 64-GT Gas-Tight Total Containment Vessel (TCV)

Development

The Model 64-GT TCV is a gas-tight version of the standard Model 64 (see separate entry).

Description

It can safely contain all of the gases generated from a detonation of up to 1.36 kg of C-4 or equivalent, or up to 6.8 kg of C-4 in the controlled venting mode. The Model 64-GT, as with all of NABCO's TCV range, can be upgraded to feature a self-closing mechanism, comprising an on-board 8 KW generator to power an automatic hydraulic door closure yoke, which provides a faster and relatively safer method of closing the vessel while in operation. An on-board 12-volt back-up power system is also available to operate the door yoke in the event of a generator failure.

The 64-GT vessel can be used for both conventional and chem-bio IEDs. In the event that a chemical or biological agent is suspected, the device can be disrupted inside the TCV and the entire vessel can then be decontaminated and flushed. Air samples from the interior can be taken to determine the appropriate treatment and to verify that the decontamination process was successful. The telescopic internal basket assembly allows the unit to be used in conjunction with EOD remotely operated vehicles, virtually eliminating human exposure during the loading process.

Modifications include a secondary airtight door installed onto the TCV. Existing vent holes are sealed and replaced with a drain post; purge port for flooding with decontamination material; sample post for testing internal atmosphere and an electrical interface to enable a charge to be detonated inside the TCV. Older gas-tight models can also be upgraded to the new BioChem-rated performance level, which allows the TCV to contain biological or chemical hazards up to the TCV's maximum rated explosive charge.

NABCO Model 64 BioChem Total Containment Vessel fitted onto a transport trailer (NABCO Inc) 1290158

Specifications

External diameter: 1.63 m
Weight: 4,994 kg
Access opening: 860 mm
Operational temperature range: –35.5 to +48.8°C

Status

In production and in service.

Contractor

NABCO Inc.

Model 64 Total Containment Bomb Vessel (TCV)

Development

The enlarged version of the Model 42 TCV (see separate entry) is particularly suited to airport environments.

Description

It offers increased explosive capacity of up to 6.8 kg of Composition 4 and can accept a full size suitcase. It can be supplied with its own transporter so that it can be driven to wherever a suspect package or suitcase is found.

NABCO 's Model 64- SCS with Model 6 trailer attached (NABCO Inc) 1298769

The Model 64TCV, as with all of NABCO's TCV range, can be upgraded to feature a self-closing mechanism, comprising an on-board 8 KW generator to power an automatic hydraulic door closure yoke, which provides a faster and relatively safer method of closing the vessel while in operation. An on-board 12-volt back-up power system is also available to operate the door yoke in the event of a generator failure. The Model 64 can also be optionally equipped with a remote closure system that moves the locking mechanism into place and tightly secures it. This system is operated with a 2-axis, variable speed hand-held joy stick connected to 5 m of cable.

Specifications

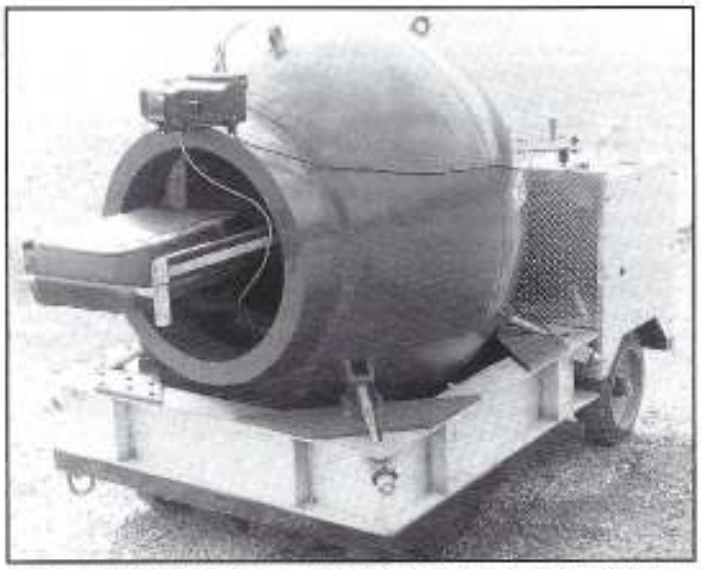
The figures in brackets indicate a variation between the standard TCV and the self-closing upgrade where applicable
Internal container diameter: 1.63 m
Weight: 4,182 (4,989.6) kg
Height: 1.91 m
Length: 1.73 m
Access opening: 810 (864) mm
Operational temperature range: –35.5 to +48.9°C

Status

In production and in service.

Contractor

NABCO Inc.



NABCO's Model 64 provides increased explosive capacity for special situations (NABCO Inc) 0074368

NABCO 42-R-ATV Restricted Access ATV Transporter

Development

The NABCO Model 42-R-ATV is a walk-behind unit similar to other NABCO ATV (All Terrain Vehicle) options, but one that has been purposefully designed to be as compact as possible, with a smaller total width, length and height, than the standard Model 42-ATV.

Description

Once the TCV (Total Containment Vessel) has been removed from its towing trailer and placed onto the 42-R-ATV, EOD crews are able to manoeuvre it into more difficult-to-reach areas, where access with the Standard ATV would be restricted.

The 42-R-ATV can be optionally fitted with Pendant or RF (Remote Frequency) Wireless control systems.

Specifications

Total weight (with TCV): 2,721.6 kg
Length: 2.59 m
Width: 2.03 m
Height: 1.80 m
Ground clearance: 228.6 mm
Turning radius: approx 3.66 m
Speed: variable, max 2.41 km/h

Status

In production and in service.

Contractor

NABCO Inc.

NABCO Model 42-R-ATV Restricted Access Transporter (NABCO Inc) 0581794

NABCO all-terrain hydraulic transporter and trailer

Development

The all-terrain hydraulic transporter enables the EOD operator to place a Total Containment Vessel (see separate entries) next to the suspect device. The transporter allows the TCV to be taken into airport terminals and can use freight elevators to gain access to high rise office buildings, sporting arenas and industrial sites.

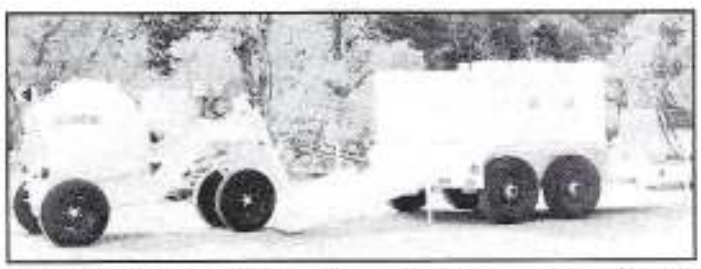
Description

The transporter is powered by a 20 hp petrol engine with electric ignition, throttle control and choke. Power steering, halogen lights and an emergency shut-off built into the operator platform enable the operator to position the TCV safely and precisely. A self-loading boom option is available to allow a suspect device to be loaded into the TCV remotely.

For transport to the incident site NABCO produce a towing trailer which can be equipped with onboard generator, halogen scene lighting, customised tool storage compartments and electrical converters. Both transporter and trailer are manufactured from aluminium to reduce weight.

Specifications

Hydraulic transporter
total width: 1.83 m
total length: 2.9 m
total height: 2.13 m



Hydraulic transporter off-loaded from trailer and ready to be driven to incident site (NABCO Inc) 0074369

Trailer
length: 3.84 m
height (including TCV): 2.44 m
bed height: 560 mm
width: 2.59 m
weight (empty): 907 kg
hitch height: to customer specifications

Status

In production and in service.

Contractor

NABCO Inc.

NABCO Model SV-23 and SV-50 storage vessel range

Development
The Model SV-23 range of storage vessels are intended for the safe storage of up to 10 kg (22 lb), 14.5 kg (32 lb) or 22.6 kg (50 lb) of fragmenting or non-fragmenting explosive, eliminating the need for storage away from headquarters' locations.

Description
The vessels have been designed to withstand multiple detonations and are approved by the US Department of Defense Explosive Safety Board (DDESB). In the case of fragmenting munitions, that approval runs for up to 40 mm diameter munitions, with larger fragmenting munitions being approved on a case-by-case basis.

The vessels are fitted with customised internal lighting. The internal storage area can be configured in several styles to accommodate different sized explosives. A turntable or shelves can be added. An optional intrusion detection system is also available.

Specifications
Height: 3.4 m
Weight: 7,272 kg
Door opening: 0.56 × 0.97 m
Internal diameter: 2.5 m

Status
In production and in service with the Federal Bureau of Investigation in the US.

Contractor
NABCO Inc.

The NABCO SV-23 can hold up to 14.5 kg of explosive
(NABCO)
1290155

NABCO TATV-01 Tracked TCV Transporter

Development
The NABCO TATV-01 is a tracked transporter that can be deployed to a suspect device without risking human exposure.

Description
The transporter can be driven using either a hard wire or optional wireless remote-control system and all opening and closing of the TCV can be performed remotely, up to a distance of 228.6 m, using the on-board NABCO Logic Control system.

The TATV-01 can also optionally be fitted with a robotic arm for remote manipulation and positioning of the suspect device, video and audio capability for easy identification purposes and an EOD disruptor for immediate disabling.

This transporter is available for both Model 42 and 64 TCVs (Total Containment Vessels).

Specifications
Weight (with TCV): Not to exceed 3,402 kg
Length: 2.057 m
Width: 2.019 m
Height: 2.13 m
Max gradient: 25°
Max speed: 4.67 km/h

Status
In production and in service.

Contractor
NABCO Inc.

NABCO TATV-01 equipped with a Model 42 TCV
(NABCO Inc)
1290159

For details of the latest updates to *Jane's Explosive Ordnance Disposal* online and to discover the additional information available exclusively to online subscribers please visit **jeod.janes.com**

Portable Total Containment Vessel (TCV)

Development
The NABCO Portable TCV is designed for one-man operation and is intended for use at post offices, airports, embassies, government buildings and corporate offices.

Description
The unit features NABCO's patented SpinSafe system enabling rapid loading. It is easily sealed by one person and can then be transported to a disposal range: no 'render safe on site' procedures are required. The manufacturer claims the portable TCV can repeatedly withstand detonation of 1.36 kg of C-4.

Specifications
Height: 1.4 m
Width: 840 mm
Access port diameter: 330 mm
Explosive capacity: 1.36 kg
Weight: 682 kg

Status
In production. In use in the US for mail screening operations.

Contractor
NABCO Inc.

NABCO Portable TCV (NABCO Inc) 0074802

Suspected Item Disposal (SID™) explosive device transport system

Description
SID™ is a commercially produced explosive device transport system designed to allow a suspect device to be moved to an area where it can be disposed of safely.

The system comprises a cylindrical blast chamber mounted on a double-axle trailer. The blast chamber consists of two closed-bottom steel cylinders, one within the other. The outer cylinder is made from 12.7 mm thick welded high-grade steel. The replaceable inner cylinder is 25.4 mm thick welded high-grade steel, fitted with an elliptical dome-shaped base and is suspended in the outer cylinder by nine rubber guides. The inner cylinder can withstand the detonation of up to 7.5 kg of TNT or equivalent.

SID™ is equipped with Farawa™, an advanced remote loading and unloading system. The operator can control the loading process by coded radio at a distance of 152 m, or by cable at a distance of up to 30 m, with the option of an extension cable for an additional 30 m. The system is programmed to stop directly over the centre of the blast chamber, preventing overtravel and eliminating guesswork.

Compact in size, the trailer can be easily towed and manoeuvred through narrow streets. SID™ also comes equipped with electric brakes on each wheel and a battery-powered breakaway system that stops the trailer if it becomes separated from the towing vehicle. The trailer's suspension consists of a 'floating, crawler' equaliser system with standard shock absorbers. This system is designed to prevent sway in the trailer, providing a smoother ride when the trailer is being towed at high speed, and optimum shock absorbency for each individual wheel when the trailer is transporting suspected items to a safe disposal site.

The system is designed so that the inner chamber and Farawa™ can be replaced in the event of damage due to explosive force, without the need to replace the entire trailer.

SID Farawa™ in action (Criminalistics, Inc) 1342131

The Farawa™ hoist lowers a suspect device into the SID™ blast chamber (Criminalistics, Inc) 0096061

The SID™ comes with an onboard power system as a standard feature, consisting of a 12 V DC gel battery with AC battery charger and solar panel with regulator to power the trailer, running lights and Farawa™ system.

The trailer can also be modified for optional custom-built onboard housing for the transport of robots, foam tent systems or other large pieces of equipment.

Specifications

SID™
weight: 2,267 kg
length: 4.572 m
width: 1.6 m
height: 1.55 m

SID™ with optional robot housing
weight: 2,585 kg
length: 5.182 m
width: 1.6 m

Farawa™
winch working load: 454 kg
actuator load rating: 90 kg
operating temperature: –22 to +50°C

Status

In production and in service with over 100 agencies worldwide.

Contractor

Criminalistics, Inc.

COUNTERMEASURES/JAMMERS

India

Bharat Improvised Explosive Device (IED) jammer

Type
IED jammer.

Description
Operating within the 10 to 500 MHz frequency band, Bharat's IED jammer is a light, vehicle-mounted, wideband, omni-directional equipment that is designed to jam and/or 'mute' radio-controlled IEDs. Installation takes the form of a single rack, with power being provided by Sealed Maintenance Free (SMF) batteries with an alternator that is coupled to the host vehicle's engine.

Specifications
Frequency: 10–500 MHz
RF output: 375 W

Status
As of March 2008, Bharat's IED jammer was reported as being 'available and in service'.

Contractor
Bharat Electronics Ltd Bangalore.

Israel

Electronic Jammer Against Bombs (EJAB)

Type
Family of remotely activated explosive charge jammers.

Description
Over time, *Jane's* sources have identified two EJAB variants, the known details of which are as follows:

EJAB-B
EJAB-B is described as being a 'smart' portable device that is suitcase-mounted and is claimed to be able to disable 'all' cellular telephone communications and provide 'full' protection against remotely activated explosive charges. EJAB-B's carrying case is waterproof and the equipment is powered by internal batteries, with the option of making use of an available external source. Again, the device incorporates internal directional antennas and can, if required, be 'easily' connected to external directional and omni-directional arrays. The operator is provided with visual and audio system operating status alarms and there is an integral remote control facility.

EJAB Light
EJAB Light (designation not confirmed) is a 'smart' vehicle-mounted jammer that is designed to provide military personnel with 'full' protection against remotely activated explosive charges. As such, it is claimed to be capable of blocking 'virtually all types of radio band' and is computer programmable. The operator uses a dedicated interface to configure preferred jam strategies that are based on the perceived environment. Within the architecture, each selected threat band has its own programmable exciter, power amplifier and antenna and there is an integral remote control facility. EJAB Light generates visual and audio alarms (which allow the operator to evaluate the system's operating status) and the system has a future upgrade option.

Status
Over time, both EJAB-B and EJAB Light have been promoted.

Contractor
Elisra Electronic Systems Ltd Bene Beraq.

United Kingdom

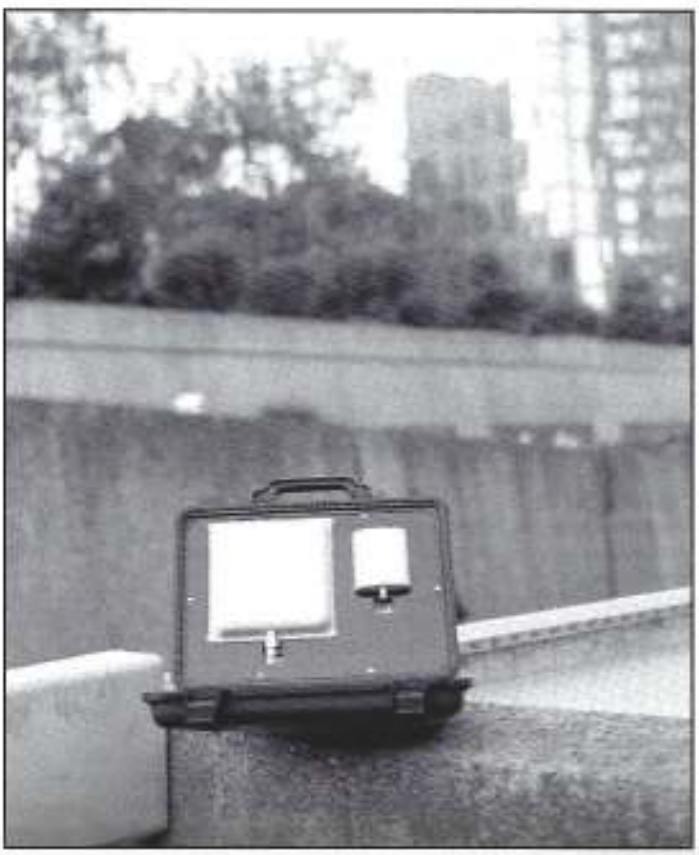
Blockphone cellular communications jammer

Development
Blockphone is a range of products designed to block mobile phones and prevent all cellular transmissions without interfering with other communication systems. It can be used for a range of applications including: prisons, embassies, VIP protection and military establishments.

Description
Blockphone is available in three different versions BP27, BP55 and BP20. When activated, Blockphone produces signals that jam cellular devices by preventing them from sending or receiving. All the incoming calls are directed to the subscriber's voice mail. With adjustable frequencies and power levels, Blockphone can be set up in any location where the use of mobile phones is prohibited or undesirable.

The BP27 is designed for indoor applications, with an approximate coverage of 10 to 15 m. BP80 is designed for outdoor applications and has an approximate coverage of 30 to 40 m. BP120 is also designed for outdoor applications and has an approximate coverage of 100 to 150 m.

All cellular standards are available (including W-CDMA (3G), WiFi, Bluetooth and so on) and Blockphone has 61 levels of digital power control. Remote control use is optional and the system can be operated from the mains or via battery. Several devices can be installed in one location to increase the operating range. Blockphone can be supplied in a waterproof case.



Blockphone cellular phone jammer
(Winkelmann (UK) Ltd)
1041263

Specifications

	BP 27	BP 55	BP 120
Height:	200 mm	340 mm	470 mm
Length:	110 mm	300 mm	380 mm
Width:	70 mm	160 mm	180 mm
Coverage:	1 to 4 bands	2 to 5 bands	1 to 4 bands
Antenna type:	Internal (external optional)	External (directional optional)	Internal (external, directional optional)
Antenna polarization:	Linear	Linear	Vertical
Battery operating time:	up to 8 h	up to 6 h	N/A
Power supply:	12 V/2A via external AC/DC adapter for Quad band	12 V DC/via external DC/DC car adapter	110/220 V (24/48 V optional)
Control interface opt.:	IR remote control		
Max radiated spurious level:	min 43 dB below max level of carrier frequencies emission	min 43 dB below max level of carrier frequencies emission	N/A
Antenna gain:	0 dBi	0 dBi	10 dBi
Operating temperature:	0 to +50°C humidity 90%	−10 to +55°C humidity 90%	−5 to +50°C humidity 90%
Standard and conformity:	D0160 D, CE compatible		

Status
In production. The use of Blockphone is strictly regulated. Any use of this type of device must be compliant with regulations and laws in force in the country concerned.

Contractor
Winkelmann (UK) Limited.

ECM (Electronic CounterMeasures)

Description
The Allen-Vanguard range of ECM equipment includes systems ranging from small backpack units for either Improvised Explosive Device Disposal (IEDD) or patrol scenarios, up to large, fully flexible digital multi-channel units for vehicle convoys or semi-permanent installations.

ECM systems are programmable and radio frequency energy can be preset to target known portions of the electromagnetic spectrum where threat equipment functions rather than waste valuable energy over a broad frequency range. This means that power can be optimised to counter those known threats.

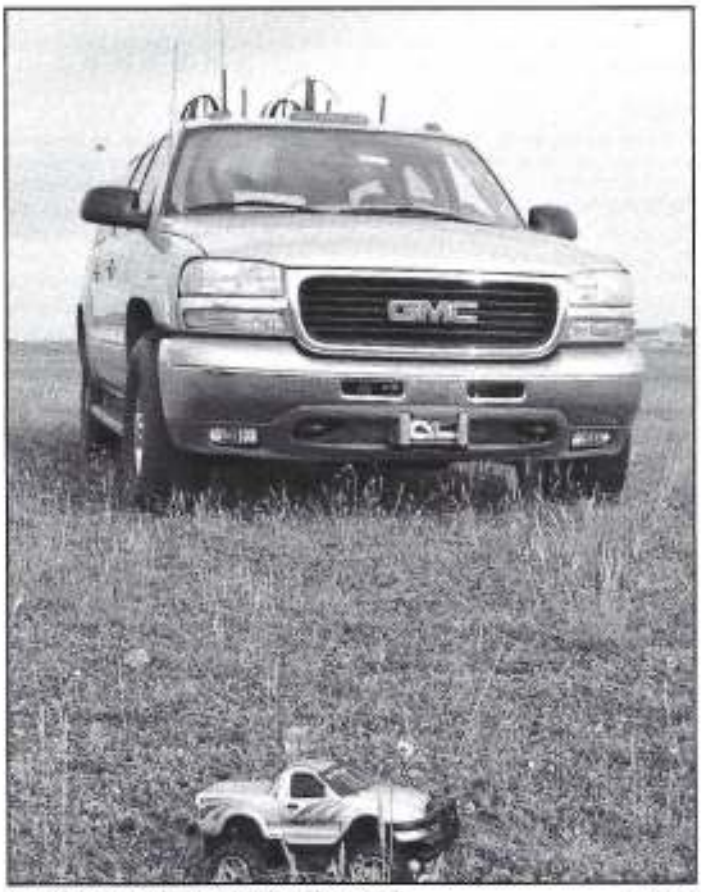
Allen-Vanguard also manufactures a hand-held RF Monitor which acts as a confidence tool for ECM system users to check that the system is operating effectively.

Specifications
Detailed technical data regarding ECM systems are available to government agencies/units and qualified individuals upon request.

Status
In production and in service. The company's ECM jammer systems are currently in service with EOD/bomb disposal experts, special operations teams, military personnel, private contractors and close protection teams.

ECM in Hummvees (Allen-Vanguard) 1341907

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).



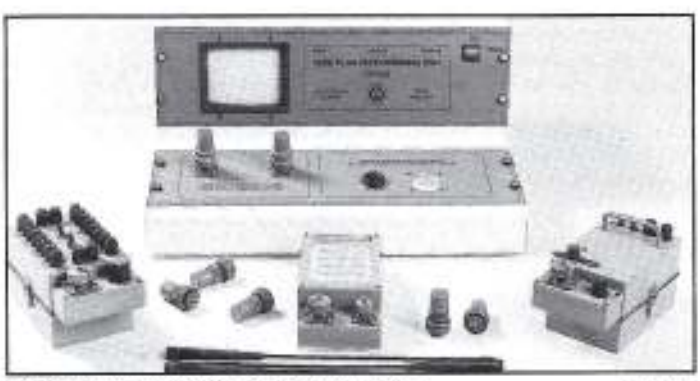
ECM fitted into GM truck (Allen-Vanguard) 1341906

Mallett broadband radio frequency jammer

Description
Mallett is an effective commercial jammer available for vehicle installations, with software programmable communications windows. The fast-sweep electronic countermeasures (ECM) system covers the frequency range of 20 to 1,000 MHz in three bands allowing 360° protection (or alternative directional format) from devices activated by modern radio control equipment, including pagers and telephones.

Status
In production.

Contractor
BDL Systems Limited.



Mallett broadband radio frequency jammer 0005752

Mandrel broadband portable radio frequency jammer

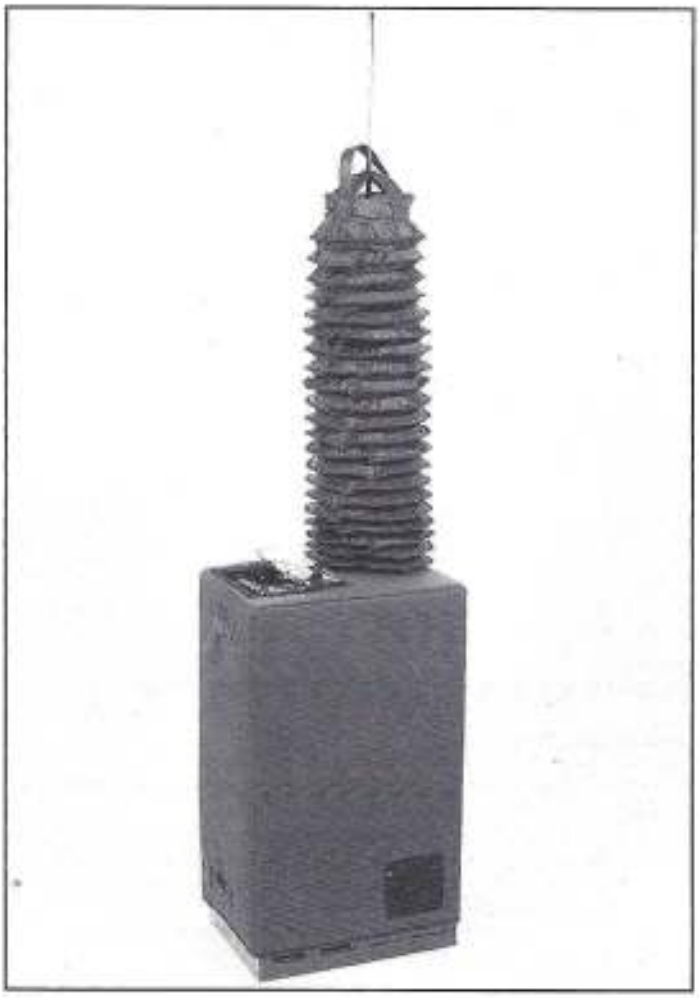
Description
Mandrel is designed to provide the user with a safe and reliable fast-sweep jamming system covering the frequencies 20 to 500 MHz. Broadband cover ensures 360° protection from devices activated by modern radio control equipment.

The system is enhanced by programmable software control that allows the user to select communications windows and to programme the actual frequencies to be jammed.

Mandrel incorporates digital signal processing for a fast and efficient control system. The system can be programmed and controlled via a remote fibre optic link or from any laptop computer. Additional batteries, or mains power, can be connected for long operational periods. The system is easily transportable by hand or with a wheeled trolley.

Status
In production.

Contractor
BDL Systems Limited.



Mandrel
(BDL Systems Limited)
0516627

PJS2 portable digital jamming system

Description
The PJS2 portable digital jamming system is designed for VIP protection and for use by EOD operators when dealing with a suspected radio-controlled device.

The PJS2 system uses broadband amplifiers and a proprietary source capable of providing communication windows, as well as broadband and spot frequency jamming. The equipment sends out a powerful 100 W propriety swept jamming signal covering frequencies from 20 MHz to 500 MHz.

Remote control is by means of umbilical cable and the control panel has an LCD alphanumeric display with waterproof keypad.

Power supply: 24 V rechargeable batteries
Dimensions
Main frame: 400 (h) × 190 (w) × 250 (d) mm
Battery pack: 200 (h) × 200 (w) × 72 (d) mm
Control panel: 230 (h) × 100 (w) × 50 (d) mm
Weight: 17 kg
Output: 100–120 W
Frequency range: 20–550 MHz

Status
Available and in production.

Contractor
SDMS Security Products Limited.

PJS2 portable digital jamming system
(SDMS Security Products Ltd)
0074801

S-Jam vehicle-mounted jamming system

Description
The S-Jam vehicle-mounted jamming system was designed for use in saloon-type vehicles that are potential targets for remote-controlled bomb devices.

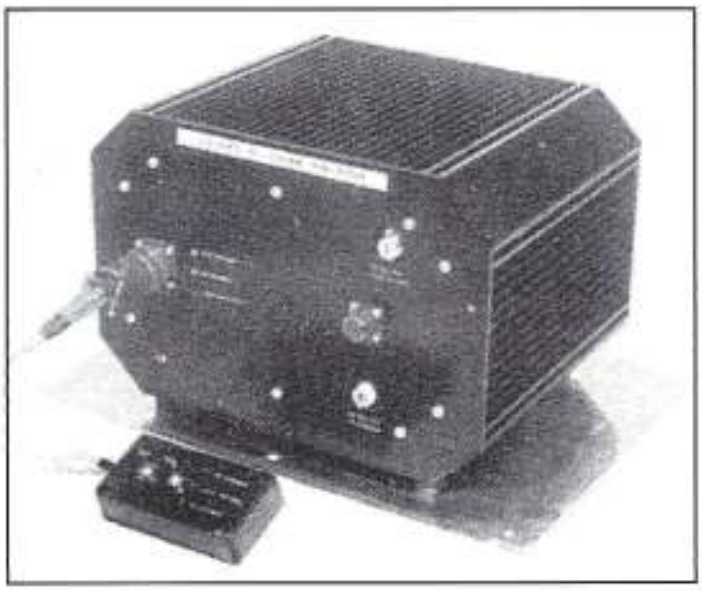
The system produces a high-powered broadband signal which will effectively cause most radio-controlled devices to either explode prematurely at a safe distance, or to jam the activation signal completely.

S-Jam has been tested by a number of government agencies and has seen widespread use, including in European NATO countries.

Specifications
Power supply: 24 V DC
Dimensions: 230 × 330 × 280 mm
Output: 100 W
Frequency range: 10–550 MHz

Status
Has seen service in European NATO and other, unspecified countries. No longer in production.

Contractor
SDMS Security Products Limited.



S-Jam vehicle-mounted jamming system
(SDMS Security Products Ltd)
0074371

SVJ4 vehicle-mounted jamming system

Description
The SVJ4 was developed to meet the requirements of professional EOD operators and for the protection of VIPs who might be targets of Remote-Controlled Improvised Explosive Devices (RCIEDs).

The system produces a 400 W broadband barrage signal which is intended to either jam receivers or cause them to activate at a safe distance – usually 250 to 300 m – from the target depending on the power of the activation transmitter. It employs the vehicle's own 24 V power supply and has been designed for ease of installation; its controls have also been kept to a minimum.

SDMS claims that the SVJ4 is effective against SC, F3, F3E, A3B and most remote-control types of radio. Its frequency coverage is from 10 MHz to 1.2 GHz in three independent bands. Each channel has its own source amplifiers and antenna. Including base plate and mounts, its dimensions are 320 (height) by 320 (width) mm.

The SVJ4 comes with anti-vibration mounts and plates, plus two cooling fans. A 5 m remote-control lead and remote-control panel allow in-vehicle control. Also featuring as part of the complete product offering are three N-type RF power cables, three vehicle antenna mounts, a low-band stainless steel whip antenna, a mid-band stainless steel antenna, a high-band antenna and high and low band high efficiency matching units.

SVJ4 vehicle-mounted jamming system (SDMS Security Products Ltd)
0074372

Status
In service in most NATO countries, as well as many other countries worldwide. No longer in production.

Contractor
SDMS Security Products Limited.

SVJ5 manpack EOD jamming system

Description
The SVJ5 is a powerful jamming system for use by EOD operators to jam radio-controlled signals when working with a suspected improvised explosive device.

The system can be used either as a portable manpack or in a vehicle, where it can operate, and be recharged, using the vehicle's 24 V supply. The equipment is fitted to a custom-made chassis and a rugged Bergen backpack frame. Quick release fittings and attachments for vehicle deployment are available.

Specifications
Power: 2 × 12 V 6 Ah rechargeable sealed lead-acid batteries
Frequency range: 20–200 MHz
Nominal output range: 150 W
Weight: 15 kg

Status
No longer in production. Replaced by the PJS2 portable digital jamming system (see separate entry).

Contractor
SDMS Security Products Limited.

SVJ5 portable jamming system
(SDMS Security Products Ltd)
0074370

SVJ8 vehicle-mounted jamming system

Description

The SVJ8 vehicle-mounted digital jamming system emits a powerful 1,050 W broadband composite jamming signal covering the frequencies between 20 MHz and 1.2 MHz, as well as the 1.8 GHz cellular telephone band. This is intended to cause all nearby receivers and transmitters to either become inactive or to activate prematurely at a safe distance, usually about 250–300 m from the target, depending on the power of the activation transmitter and the relative distances involved. As the SVJ8 is digital, this adds flexibility. For example, fully adjustable communication windows can be programmed into the handheld controller in seconds and the power output can be concentrated into particular spot frequencies if required.

The SVJ8 can be powered by a vehicle's own 24 V supply or from separate car batteries or mains power. The manufacturer claims that it is effective against SC, F3, F3E, A3B and most remote-controlled types of radio, as well as cellular telephones. It is fitted with anti-vibration mounts and plates with integral cooling fans, comes with a 5 m remote-control lead and remote-control panel for in-vehicle control, DC input lead, digital programmer, antennas and high efficiency matching units. Installation and commissioning instructions are provided by SDMS but these can also be undertaken in-country by the company.

Specifications

Frequency coverage: 20 MHz – 1.2 GHz and 1.8G Hz in four independent bands:- 20–200 MHz, 200–500 MHz and 500 –1,200 MHz and 1,800 MHz
Power supply: 24V DC at a nominal 75 A
Operating temperature: –10 to +50°C
Humidity: 5% to 95% RH
Output: 1,000 W
Dimensions: 320(h) × 790(l) × 320(w) mm, including base plate and mounts

SVJ8 vehicle-mounted digital jamming system
(SDMS Security Products Limited) 1334731

Weight: 75 kg (excluding antennas)
NATO stock no: 5865-99-488-7615

Status

In service. No longer marketed by SDMS.

Contractor

SDMS Security Products Limited.

SVJ10 Vehicle-Mounted Digital Jamming System

Development

The SVJ10 vehicle-mounted digital jamming system was designed specifically for vehicle-mounted use to protect top-level VIPs from possible radio-controlled bomb devices. SVJ10 was primarily introduced to provide additional cellular telephone jamming capability, including 3G and wireless LAN, as a counter-measure to the increased incidence of terrorists using cell phone infrastructure to detonate remote control bombs.

Description

The SVJ10 emits a powerful broadband jamming signal covering the frequencies between 20 MHz and 2.5 GHz. The Direct Digital Synthesis (DDS) technique permits the use of new, energy-efficient counter-measures that the manufacture believes provides a greater range of lower overall output power.

The SVJ10 causes nearby receivers and transmitters to either become inactive or to activate prematurely at a safe distance, usually about 250 to 350 m from the target, depending on the power of the activation transmitter and the relative distances involved. As the SVJ10 is digital, this adds flexibility. For example, fully adjustable communication windows can be programmed into the hand-held controller in seconds and the power output can be concentrated into particular spot frequencies if required.

The manufacturer claims that the SVJ10 is effective against SC, F3, F3E, A3B and most remote-controlled types of radio, as well as cellular telephones. It is fitted with anti-vibration mounts and plates with integral cooling fans, comes with a 5 m remote-control lead and remote-control panel for in-vehicle control, DC input lead, digital programmer, antennas and two low-band high efficiency matching units. Installation and commissioning instructions are provided by SDMS but these can also be undertaken in-country by the company.

Specifications

Frequency coverage: 20–2,500 MHz in 11 independent bands
20–80 MHz, 80–200 MHz, 200–500 MHz (dual channel), 500–975 MHz, 975–140 MHz, 1,450–1,925 MHz, 1,925–2,400 MHz, 900 GSM
Power supply: 24 V DC at a nominal 50 A
Operating temperature: –10°C to +50°C
Humidity: 5% to 95% RH
Output: 650 W

SVJ10 vehicle-mounted digital jamming system
(SDMS Security Products UK Ltd) 1299214

Dimensions: 320(h) × 790(l) × 320(w)
Weight: 75 kg (excluding antennas)
NATO stock no: 5865-99-700-8711

Status

Available. In production.

Contractor

SDMS Security Products Limited.

Viper ECM4 EOD barrage jammer

Description

Viper is a portable/vehicle-mounted mid-power wideband barrage jammer powered by external rechargeable batteries and supplied as standard with a user-programmable communications window. As a barrage jammer, all frequencies in the bands 10 to 500 MHz are simultaneously jammed. Viper can feature a second communications window and/or user-programmable point frequency jamming channels.

A disruptive signal at 170 W (RMS) is radiated from a single wideband loaded whip/collapsible or tuned antenna, which will affect or inhibit communications and most radio-controlled systems at significant range.

Ancillary equipments include: 100 m remote control, AC power supply, vehicle installation kit, shoulder bag and backpack.

Viper ECM4 is a stand-alone system or it can be used in conjunction with other building/surveillance jammers manufactured by Circuitwise Electronics.

Specifications
System frequency: 10–500 MHz
Output power: user variable to 170 W RMS
Dimensions: 300 x 300 x 125 mm
Weight: 6.8 kg
Classification: wideband, barrage/jammer with communications windows
DC power: external rechargeable 24 V DC battery pack, external battery pack, AC supply, converter

Status
Unknown.

Contractor
Circuitwise Electronics.

Viper ECM4 EOD barrage jammer (Circuitwise Electronics) 0516173

United States

Bombjammer™ jamming systems

Description
The Bombjammer™ systems from Homeland Security Strategies are designed to protect against the threat of Remote-Controlled Improvised Explosive Devices (RCIEDs).

A wide range of devices are available, from briefcase-sized for the protection of individuals through stationary to jammers for buildings and border crossing checkpoints, to systems designed to protect large gathering areas such as sports complexes and stadiums. Vehicle-mounted systems can be used to protect a single vehicle or convoys.

GAUNTLET
GAUNTLET is an IED pre-detonation system that targets IEDs, suicide bombers, car bombs and other explosive devices and causes a forced pre-detonation at a safe stand-off distance from friendly personnel.

VIP-200 Portable Jamming System
The VIP-200 jamming system is built into a briefcase. It is designed to defend the user against RCIEDs, transmitting high power radio waves to obstruct the triggering of radio-controlled detonators.

VIP-300 D digital programmable jammer
The VIP-300 D is a vehicle-mounted Radio Frequency (RF) jamming system designed to counter RCIEDs. Using a laptop and Geographical User Interface (GUI), the system allows the operator programmability in order to select desired jamming frequencies, dwell time, frequency windows and output power. The complete system is fitted on top of a vehicle in a rack-mounted case.

VIP-300 T Covert Truck-Mounted Bomb Jammer
The VIP-300 T jammer is a heavy-duty IED system installed into the boot of a car, the rear of a truck or into an armoured vehicle. It is designed to saturate the environment with RF pulses of electro-magnetic energy. These pulses prevent radio receivers found in RCIEDs from receiving their detonation signals.

VIP-300 U
The VIP-300 U is designed to counter RCIED threats in the VHF, UHF and microwave frequency ranges. Supplied in two field-transportable carrying cases, it is configured for rapid field deployment on both mobile and fixed platforms. The basic system can be expanded to provide contiguous frequency coverage, as well as increased power output, by the addition of jamming modules.

VIP-300 X Convoy Mobile Bomb Jammer
The VIP-300 X is a vehicle-mounted modular radio signal IED jammer, designed to counter RCIEDs. It is designed to prevent detonations activated by mobile phones, walkie talkies, garage door transmitters and other simple transmitters. The complete system fits on top of a vehicle in a rack-mounted case. Defence against multiple threats can be factory-set or selected by the user during operation.

VIP-900 Mounted Facility System
The VIP-900 is a fixed, mounted modular radio signal jamming system for the defence of government installations, border checkpoints, barracks, embassies and other locations. It works by transmitting RF jamming signals or radio interference to prevent detonation of RCIEDs. It can be configured to accommodate structural designs and local terrain.

Status
Available. Successfully deployed in Afghanistan, Indonesia, Iraq, Lebanon and Saudi Arabia.

Contractor
Homeland Security Strategies Inc.

Warlock Improvised Explosive Device (IED) jammers

Description
Described as being a 'modified' version of SEPS, the ITT Electronic Systems (formerly EDO Communications and Countermeasures Systems) Warlock family is a range of electronic force protection equipments that were initially designed to counter the threat posed by IEDs of the types used against US forces operating in Afghanistan and Iraq (Operations 'Enduring Freedom' and 'Iraqi Freedom' respectively). Over time, *Jane's* sources have identified the following Warlock variants:

Warlock Blue
Warlock Blue is a 0.5 W, body-worn, IED jammer that is the 'size of a walkie-talkie [radio]', is powered by CR123 lithium batteries and was developed by the United States (US) Navy's Naval Explosive Ordnance Disposal Technology Division and produced (an initial 6,500 systems

The Warlock Red IED jammer (Jane's/IDR) 1123987

by September 2005, with the US Army being reported as negotiating to procure an additional 3,500 such devices during June 2005) by US contractors ITT and Tyco.

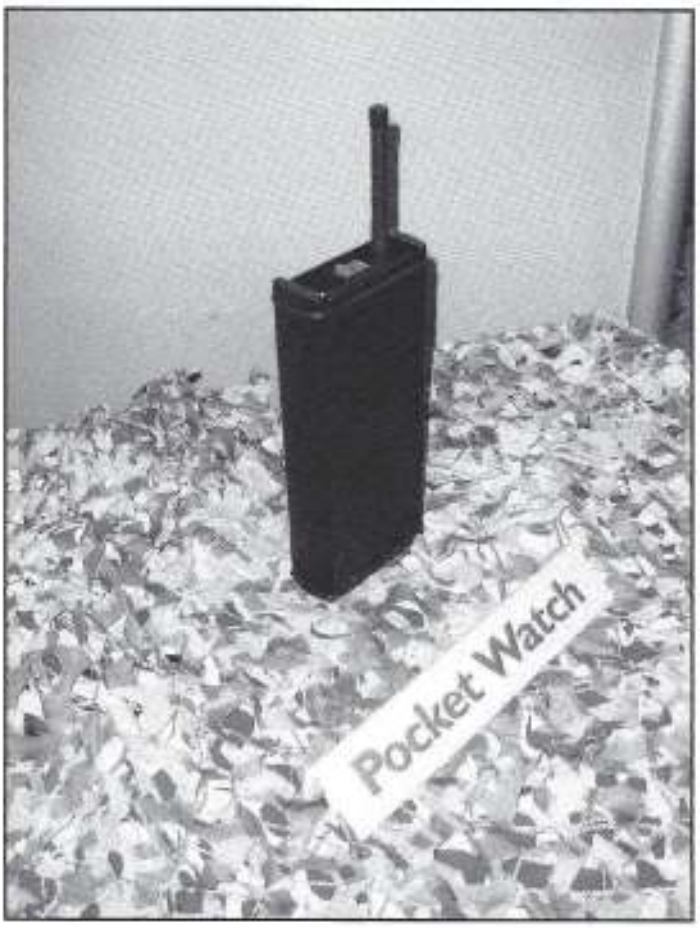
Warlock Green
The Warlock Green IED jammer is described as being a 'more capable [than Warlock Red]' equipment designed to counter 'more sophisticated' IED threats than the Warlock Red system. Unconfirmed sources suggest a Warlock Green unit price of USD100,000 at 2004 Dollar values.

Warlock Pocket Watch
The Warlock Pocket Watch IED jammer is described as being an EDO private-venture that is a body-worn device designed for use by dismounted troops and which makes use of a conformal antenna built into the user's load-carrying vest.

Warlock Red
The Warlock Red IED jammer is described as being a 'low-cost' device developed to counter 'specific threats' (thought to (but not confirmed as) include IED triggers based on radio frequency key fobs and 'wireless doorbells').

Status
In terms of Warlock Green/Red activity, *Jane's* sources report that as of early 2005, the US Army had procured 2,439 baseline vehicle-mounted Warlocks at a cost of then year USD87 million.

Contractor
ITT Electronic Systems.



The Warlock Pocket Watch IED jammer
(Jane's/IDR)
1123868

DETECTION EQUIPMENT – METAL DETECTORS (PORTABLE)

Australia

F1A4 series detectors

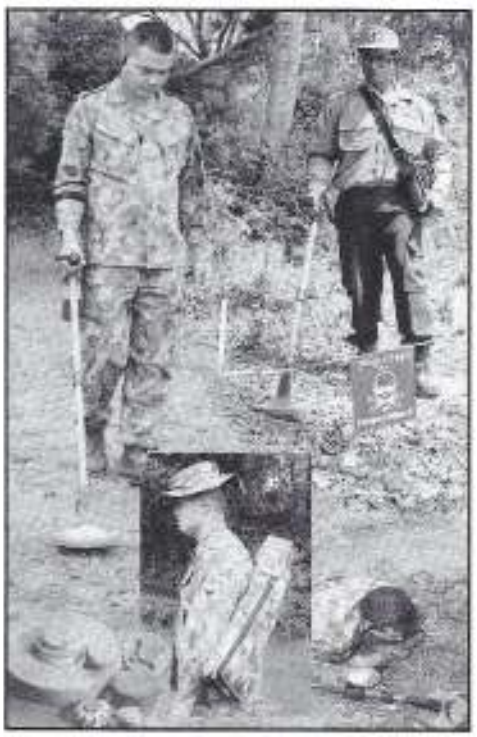
Description
Originally designed for, and selected as the detector of choice for the Cambodian Mine Action Centre, Minelab's F1A4 introduced a unique and patented technology that enhances metal detection capability in mineralised soils. With the proven success of the F1A4 in the difficult conditions of Cambodia, and following several international comparative evaluations, the F1A4 is now in operation in over 50 countries.

The F1A4 is designed for simple operation and incorporates features to ensure that safety is emphasised. It is suited for the requirements of humanitarian demining and military countermine operations and requires minimal operator training. Furthermore, the F1A4 requires no calibration, thus allowing for the interchange of parts and thereby simplifying repair and maintenance.

The F1A4 control box can be mounted on the shaft or connected by cable to be slung from the operator. Controls are simple and functional, allowing the operator to concentrate on mine detection drills once clearance operations commence. The F1A4 uses a monoloop coil that ensures equal sensitivity around the perimeter of the coil and, consequently, pinpointing is both fast and extremely accurate.

The F1A4 can be provided in an unexploded ordnance (UXO) configuration through the connection of a 450 mm UXO coil.

Specifications
Length (packed): 710 mm
Length (operating): 1,200–1,450 mm
Shipping weight: 9 kg
Operating weight
shaft mount control box: 3.1 kg
hip mount control box: 1.5 kg
Packed weight (backpack): 4 kg
Power: 4 × 1.5 V LR 20 rechargeable batteries
Audio outputs: earset, internal speaker
Data output: RS232
Operating temperature: –30 to +60°C



The F1A4 detector (Minelab) 1179384

Status
In production (Version 8).

Contractor
Minelab Electronics Pty Limited.

F3 metal mine detector

Description
Minelab's F3 detector features a combination of detection capability, safety, robustness and simplicity of use that builds on the extremely successful F1A4 (see separate entry), which incorporates Minelab's patented Multi-Period-Sensing (MPS) technology designed to eliminate the effects of mineralised soils without a loss in sensitivity. The adaptation of MPS into a Bi-Polar format means that the F3 has the ability to combat the threat posed by magnetically influenced mines.

With no exposed cables, the one-piece detector can be configured for use in a variety of positions due to its telescopic shaft and tilting coil. The ergonomics of the F3 make it ideally suited for humanitarian demining and military countermine operations.

Minelab's design philosophy emphasises safety and consequently the potential for an operator to accidentally change the sensitivity of the detector through the manipulation of dials or switches has been removed. In contrast, the sensitivity of the F3 can only be varied by changing coloured sensitivity endcaps, located on the back of the detector. Consequently, the sensitivity level of the detector is clearly evident to the operator and any observer.

The F3 uses a monoloop coil that ensures equal sensitivity around the perimeter of the coil. This ensures that pinpointing is both fast and extremely accurate.

The F3 controls have been kept to a minimum, thereby freeing the operator to concentrate on clearance drills. All controls are conveniently located on the handle assembly and are colour-coded for ease of reference and training.

Specifications
Operating length: 760–1,500 mm
Operating weight
with battery pack: 3.2 kg
without battery pack: 2.35 kg
Packed weight
hard transport case: 12.6 kg

A US Marine with Minelab F3 detector (Minelab) 1179394

The complete F3 system in carrying case (Minelab) 1179388

Two F3 detectors (Minelab) 1179391

Deminer in Lebanon using the F3 (Minelab) 1344763

Transmission: Multi-Period-Sensing Bi-Polar
Audio output: earset, internal speaker
Power: 4 × 1.5 V LR20 rechargeable batteries
Data output: RS232
Operating temperature: -30 to +60°C
Design standard: MIL STD 810 F

Status
In production and subject to design improvements.

Contractor
Minelab Electronics Pty Limited.

Austria

Schiebel All-Terrain Mine Detector (ATMID™)

Development
The ATMID™ All-Terrain Mine Detector has been designed to meet the needs of mine clearance professionals on the battlefield and in post-conflict humanitarian demining.

Description
The ATMID™ has been engineered to detect low metal content mines in all types of soils and terrain conditions and is claimed to be especially effective in areas with dense laterite and magnetite conditions (high content of iron or aluminium oxides). The ATMID™ retains the basic configuration of the AN-19/2 (see separate entry) widely used in military, humanitarian and commercial mine clearance.

ATMID™ incorporates digital technology and updateable algorithms to compensate for ground and soil effects and to provide reliable and consistent mine detection. Designed with simple sensitivity setting and discrimination control, the lightweight ergonomic configuration aids operator comfort during sustained use. Built-In-Test (BIT) circuits automatically check all critical functions and battery condition and the sensitivity is independent of ambient temperature and battery charge. A distinctive detection signal, free of side tone and static, aids the location of targets.

The watertight electronics unit contains the control panel, printed circuit board and battery compartment. The control panel features sockets for the search head and headphone plugs, and all operational controls. The ATMID™ search head contains a moulded antenna array with integrated noise reduction features. An adjustable handgrip and arm support fitted to a telescopic pole provide operator comfort during extended use. The single speaker headphone is designed for wear under a ballistic helmet. ATMID™ is supplied with a backpack-style carry bag with individual accessory pockets containing all parts and accessories. The carry bag and all components fit into a watertight aluminium transport and storage case.

During operation (in Continuous Wave (CW) mode), the search head is moved over the ground at a rate of approximately 0.5 m/s. A clear distinctive signal sounds in the headphone when the head passes over a metal object. The acoustic signal changes in volume and frequency to pinpoint the location. Maximum intensity is reached directly over the object. ATMID™ requires only minimum training for effective operation.

When the existing AN-19/2 search head is connected, ATMID™ automatically behaves and is operated in exactly the same manner as the latest version of the AN-19/2.

Schiebel ATMID™ with carry bag and watertight transport and storage case (Schiebel) 0074020

Specifications
Type of batteries: IEC standard size LR20; ANSI standard size D
Number of batteries: 4 × 1.5 V dry battery cells
Typical endurance at medium temperature with alkaline batteries: 70 h
Dimensions
search head diameter: 287 mm
telescopic pole: 1,400 mm full extended, 770 mm collapsed
transport case: 802 × 315 × 125 mm
electronics unit: 185 × 80 × 150 mm
Weight
detector: 6.30 kg
electronics unit: 1.08 kg
carry bag: 1.44 kg
transport case: 2.2 kg
Storage temperature: –55 to +85°C (–67 to +185°F)
Operational temperature: –40 to +70°C (–40 to 158°F)
Operating time: 70 h (medium temperature with alkaline batteries)

Status
In production. In service in Bhutan, Cambodia, Croatia, Ecuador, India, Lebanon, Mozambique, Nicaragua, Pakistan, Peru, Poland, Slovakia, the United States and Vietnam.

Contractor
Schiebel Elektronische Geräte GmbH.

Schiebel AN-19/2 Mine Detecting Set

Development
The AN-19/2 Mine Detecting Set, developed by Schiebel, is widely used by military and humanitarian organisations throughout the world. From its inception the system has undergone continuous improvement, while still maintaining its original mechanical design, thus enabling users to upgrade their current systems without the additional cost of procuring new equipment.

Description

The AN-19/2 Mine Detecting Set is designed to detect metallic objects and plastic mines with minimal metal content. The system produces minimum mutual interference between adjacent detectors and has a high degree of discrimination regardless of ambient temperature and battery condition. Also inherent in the system is the ability to maintain search sensitivity independent of search head speed, from standstill to normal speed. The lightweight search head can also detect metallic objects in shallow fresh water or seawater.

Many improvements to the AN-19/2 Mine Detecting Set have included: increased sensitivity; detection head shielding; prolonged battery life; increased cable protection and numerous mechanical improvements. In 1998 Schiebel introduced additional improvements to deal with heavily mineralised soil (see separate entry for Schiebel ATMID™).

The main components of the AN-19/2 are the electronics unit, the search head with its telescopic pole and cable, the headphone and the carrying bag. An aluminium case is provided for transport and storage.

The electronics unit contains the control panel, the internal printed circuit board (PCB) and the battery container. There are sockets on the control panel for the headphone cable plug and the search head cable plug. When the plugs are removed the sockets are protected by rubber caps. The control panel contains the power switch, headphone volume control, sensitivity control knob and the failure warning lamp. The PCB is sealed within the case; the waterproof and leak-proof battery container holds four 1.5 V R20 batteries. There is a Built-In-Test (BIT) circuit for function and battery condition checks.

The search head consists of concentric transmitter and receiver coils embedded in plastic. This lightweight head design permits visual inspection of the ground during detection. The coils are connected to the electronics unit via a cable and plug. The cable is made of a special rubber material that remains flexible down to –40°C. The cable is secured to the telescopic pole with cable clamps allowing the search head to be changed in the field. The telescopic pole consists of an inner and outer tube, an arm support cup and adjustable handle. The inner tube is made of glass reinforced plastic (GRP) and the joint between the search head and the pole has a plastic shear bolt designed to break if excessive force is applied to the pole. A spare bolt is supplied in the carrying bag.

The headphone, which can be worn under a helmet, has a single side speaker so that the operator can also hear surrounding noises. The carrying bag can be worn as a backpack and contains all the sections of the AN-19/2, plus spare batteries.

During operation, the transmitting coil in the search head is energised by electrical pulses to build up a magnetic field. The field induces eddy currents in metal objects in the vicinity, which give rise to a secondary field to be detected by the receiving coil. The signal from this coil is processed in the electronics unit to create a sound in the headphone. Approximately 3 minutes are required to prepare the equipment for operation. An operator can be fully qualified to use and maintain the equipment after 8 hours of training.

AN-19/2 Mine Detecting Set (Schiebel)
0023994

Specifications

Weight
- set with bag and batteries: 6.02 kg
- search head with telescopic pole: 1.22 kg
- electronics unit: 1.02 kg
- headphone: 0.17 kg
- carrying bag: 1.41 kg
- transport case: 2.2 kg

Dimensions
- transport case: 800 × 315 × 125 mm
- electronics unit: 185 × 80 × 150 mm
- search head diameter: 267 mm
- telescopic pole length: 770 to 1,600 mm

Battery voltage: 6 V
Battery life: 70 h
Operating temperature: –40 to +70°C
Storage temperature: –55 to +85°C

Detection range
- mine with 0.15 g metal content: up to 100 mm
- typical anti-tank mine: up to 500 mm

NATO stock numbers: 6665-21-906-1023
6695-12-316-9427

Status

In production. In service with Austria, Canada, Germany, some Gulf states, India, Italy, Netherlands, Sweden, Thailand, Turkey, the UK (700) and the US Army (over 20,000 units). Also used by the United Nations, and other forces operating in Afghanistan, Angola, Cambodia, Lebanon, Mozambique, Somalia and the former Yugoslavia.

Contractor

Schiebel Elektronische Geräte GmbH.

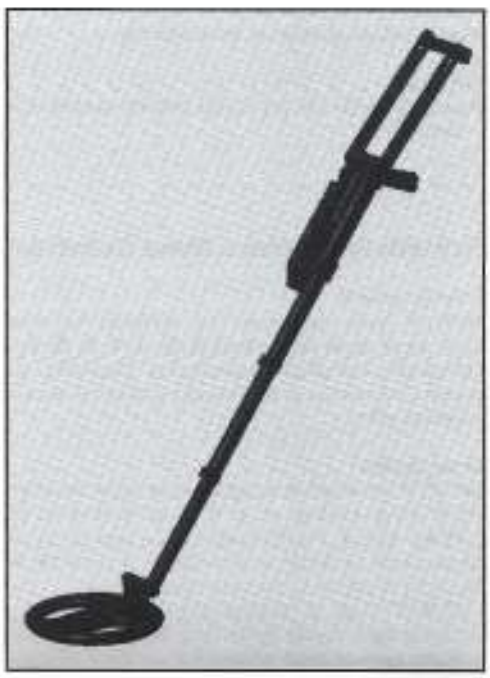
Schiebel Compact Mine Detector (COMID™)

Description

The COMID™ Compact Mine Detector combines the versatility and precision of the ATMID™ All-Terrain Mine Detector with the compact, lightweight design of the MIMID™ Miniature Mine Detector (see separate entries). COMID is designed for military demining operations for use by light and special forces.

COMID can be used in heavily mineralised soils and features a larger search head and ground compensation algorithms in a lightweight and compact design. It can also be used underwater, at depths of up to 0.3 m. The addition of an infra-red data port enables new software versions to be downloaded, including special versions customised to individual locations.

The equipment is supplied with an upholstered fabric carry bag providing extra pockets for spare batteries, a test piece and an optional titanium mine probe. The unit can also be equipped with a waterproof headphone, which allows operation by divers in water up to 30 m (100 ft) deep.



COMID™ compact mine detector (Schiebel)
1041238

Specifications

Type of batteries:
- IEC standard size LRG
- ANSI standard size AA

Number of batteries: 4 × 1.5 V
Nominal voltage: 6 V DC
Current consumption: up to 150 mA
Auxiliary supply: 5 to 16 V DC
Dimensions folded: 350 × 80 × 270 mm
Length fully extended: 1.260 m

Weight
complete unit: 1.7 kg
carry bag including accessories: 0.7 kg
headphone – (optional): 0.17 kg
Storage temperature: –55 to +85°C (–67 to +185°F)
Operational temperature: –40 to +70°C (–40 to +158°F)
Relative humidity: up to 95% RH
Submersed operations: up to 30 m (100 ft)

Status
No longer available.

Contractor
Schiebel Elektronische Geräte GmbH.

Schiebel Digital Magnetic Anomaly Detection System (DIMADS™)

Description
The DIMADS™ (formerly called the AN-23/2 bomb locating set) is designed to locate ferromagnetic objects such as unexploded ordnance underground or in water. It features a unique pair of 3-axis fluxgate sensor arrays that provide the operator with accurate target information.

The electronics unit holds an industry standard microprocessor and is swivel-mounted to the telescopic handle. It features a graphic interface based on icons that enables the operator to easily task all functions. The push-buttons next to the liquid crystal display (LCD) are located to facilitate simple selection of the individual operational modes and display functions.

The software executed in the electronics unit supports multiple users, storing preferences for data display format and language. The electronics unit has sufficient internal memory to store a day's work and includes all interfaces required for acquisition and transfer of position and target data. The downloading of data to a host PC can be made in real-time by means of a radio datalink or after completion of data collection via cable connection. Position information data can be obtained by conventional methods or from a Differential Global Positioning System (DGPS).

The detection head includes two sensitive vertically separated 3-axis sensors. These allow magnetic field vector determination, thereby improving the accuracy of buried ferrous object location and orientation. Although no larger than a conventional gradiometer, the detection head provides more accurate target data. The head provides the pre-processed magnetic field data via a standard RS-485 serial interface to the electronics unit. Using an extension cable it can be operated remotely at distances in excess of 100 m from the electronics unit. Identification and calibration data are permanently stored in each detection head. The detection heads are fully interchangeable without calibration and two or more can be interconnected to form an array for wide area search applications. The head can be used also as a stand-alone unit and directly connected to a host PC.

The DIMADS™ comes with a software package for visualisation, processing and analysis of detection data on an IBM-compatible PC in a user-friendly Windows 95/98/NT environment. When real-time connection to the DIMADS™ is established, detection data appear on the screen as work progresses. The software package supports simultaneous display of data from multiple users, and allows them to save data in a Geographical Information System (GIS) compatible format.

The watertight aluminium transport case contains all parts and accessories required for operation.

Schiebel DIMADS™
(Schiebel)
0023996

Specifications
Type of sensors: 3-axis solid-state fluxgates
Number of sensors: 2
Type of display: LCD
Resolution: 320 × 240 dots
User interface: graphical, based on icons

Interfaces
Positioning: RS-232 for DGPS (NMEA standard), or distance measuring rope
Data transfer: RS-232 for VHF or wire
Detection head: RS-485 (allows arraying of multiple detection heads)

Type of batteries:
IEC standard size LR 20
ANSI standard size D
Number of batteries: 8 × 1.5 V cells
Nominal voltage: 12 V DC
Dimensions
Electronics unit: 205 × 153 × 53 mm
Detection head: 46 × 46 × 600 mm
Telescopic handle: 1,400 mm (fully extended)
Transport case: 1,200 × 250 × 300 mm
Weight
set complete: 5.8 kg
transport case: 7.5 kg
Storage temperature: –20 to +85°C
Operational temperature: –10 to +70°C
Relative humidity: up to 95% RH

Status
No longer in production. In service with Italian and United States forces and with non-governmental organisations and unexploded ordnance clearance companies.

Contractor
Schiebel Elektronische Geräte GmbH.

Schiebel Miniature Mine Detector (MIMID™)

Development
MIMID™ was developed by Schiebel to meet specific operational requirements set out by the US Army Night Vision and Electronic Sensors Directorate (NVESD) Humanitarian Demining Team. It is based on the proven technology of the AN-19/2 (US Army designation AN/PSS-12) – see separate entry.

Description
MIMID™ is a one-piece, lightweight mine detector designed to be used as a primary demining tool or to supplement other counter-mine systems.

When folded, the detector can be carried on a soldier's web belt, in a trouser side pocket or in a rucksack. This unique feature allows operators immediate access to the unit when needed.

MIMID™ has a headphone socket and an internal speaker that automatically mutes when the external headphone is connected. The volume control knob allows for continuous adjustments. In addition, a light emitting diode bar indicator is integrated into the housing, providing constant readout of the detection signal strength. This bar indicator further enhances the ability to locate the exact centre of the mine.

The detector can be set up for operation in less than 30 seconds, and has controls similar to those of the AN-19/2; operator training requires only a few minutes. The length of the telescopic pole can be adjusted for operation in upright, kneeling or prone positions. An auxiliary power input allows for operation from external supply, such as vehicle power, batteries or a solar panel. The MIMID™ comes with an upholstered fabric carrying case which provides extra pockets for spare batteries, a test piece and an optional titanium mine probe. In addition, the unit can be equipped with a waterproof headphone which allows operation by divers in water up to 30 m (100 ft) deep.

Specifications
Type of batteries:
IEC standard size LRG
ANSI standard size AA

MIMID™ can be used at depths of up to 30 m (Schiebel) 0569500

MIMID™ folded (Schiebel) 0569501

Number of batteries: 4 × 1.5 V
Nominal voltage: 6 V DC
Current consumption: up to 150 mA
Auxiliary supply: 5 to 16 V DC
Dimensions folded: 328 × 102 × 56 mm
Length fully extended: 1.262 m
Weight
complete unit: 1.36 kg
carry bag including accessories: 0.48 kg
headphone (optional): 0.16 kg

Storage temperature: –55 to +85°C (–67 to +185°F)
Operational temperature: –40 to +70°C (–40 to +158°F)
Relative humidity: up to 95% RH
Submersed operations: up to 30 m (100 ft)
Operating time: 7 h (medium temperature with alkaline batteries)

Status
In production. In service with US special forces and other military units, ordnance clearance and demining teams, Egyptian military deminers and other unspecified organisations.

Contractor
Schiebel Elektronische Geräte GmbH.

Bulgaria

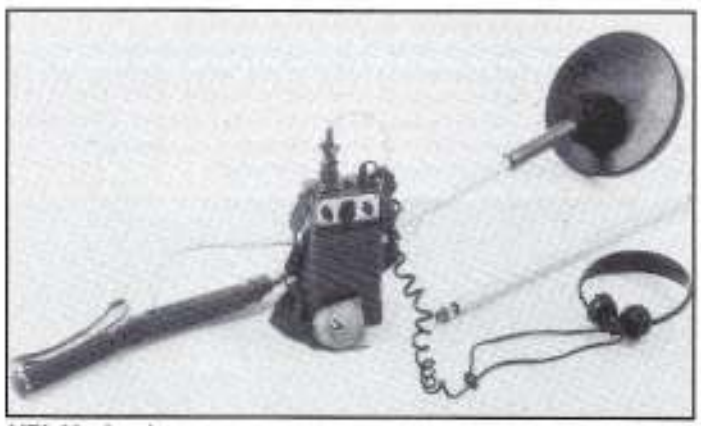
MTA-86 mine detector

Description
The MTA-86 is claimed to be capable of detecting both metallic and minimum-metal mines. The detector head assembly is circular and is mounted on a telescopic handle. The power source and operating controls are carried in a separate shoulder-slung, moisture-proof pack. The MTA-86 can detect metallic Anti-Tank (AT) mines buried to depths of 130 mm. Detection signals are provided aurally through a pair of operator headphones.

Specifications
Battery: 12–16 V (lithium)
Duration: up to 100 h
Weight (complete): 4 kg
Operational temperature range: –40 to +50°C

Status
No longer offered for export or produced.

Contractor
Marketing Agency
Kintex.



MTA-86 mine detector 0512205

Canada

EM61HH-MK2 detector

Description
The EM61HH-MK2 is a hand-held complementary detector to the EM61-MK2 (see separate entry), designed to provide greater sensitivity to smaller targets at shallow depths. A single 20 mm projectile can be detected to a depth greater than 0.5 m. Comparatively, a single 200 litre (55 gallon) drum can be detected to depths of greater than 2 m.

Data is collected from a single receiver at four time gates after transmitter turn-off. Information from four gates provides for the discrimination of targets based on the response decay rate; the early time data will detect both small and large targets with short and long decay rates respectively, while the late time data will detect only larger targets with relatively long response decay.

With a narrower spatial focus than the standard EM61-MK2, the EM61HH-MK2 is relatively less sensitive to sources of potential interference. As a result, data can be collected in closer proximity to features such as fences and buildings. Additionally, the narrower focus provides enhances target resolution, and consequently improves discrimination of multiple targets.

Data acquisition is supported by an Allegro CX field computer. Features include real-time graphic display of data for review and quality control; high-capacity data storage for extended survey time; increased rate of data collection; and additional input connections for simultaneous collection of EM and GPS data.

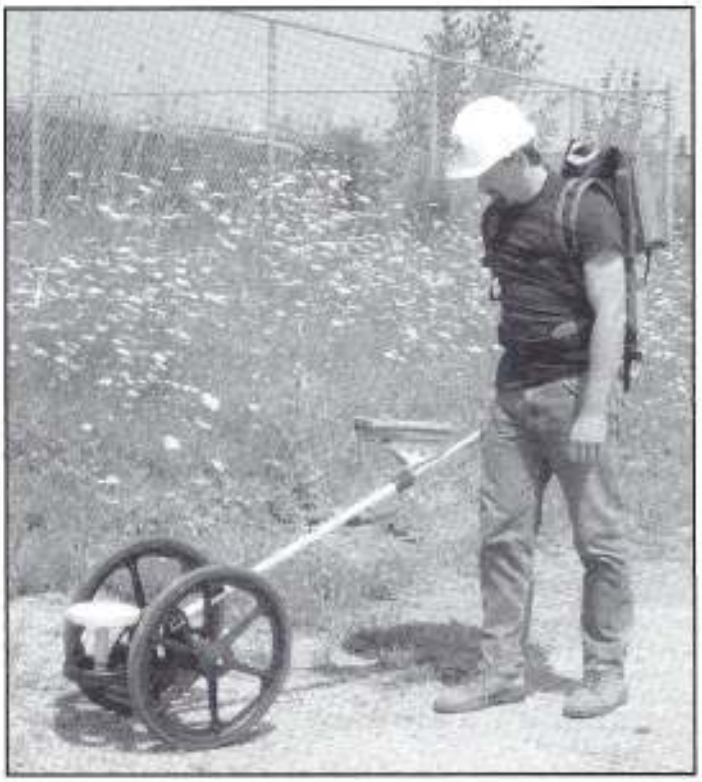
The EM61HH-MK2 can be operated either with or without wheels. In either configuration, the smaller more portable design offers improved access to areas of difficult terrain and dense vegetation.

GPS integration is available with any configuration.

Specifications
Measured quantities: four time gates of secondary response in mV
EM source: air-cored coil, 0.17 m in diameter
Current waveform: unipolar rectangular current with 25% duty cycle
EM sensor: air-cored coil, 0.17 m in diameter
Measuring ranges: 10,000 mV
Dynamic ranges: 18 bits
Output monitors: 16-line graphic LCD with 24 characters per line, and audio tone
Data storage: 330,000 data sets
Data output: RS-232 serial port
Power supply: 12 V rechargeable battery for 4 h continuous operation
Operating weight
backpack: 8 kg
sensor assembly: 2.8 kg (7.5 kg with wheels)
Dimensions
backpack: 0.6 × 0.3 × 0.2 m
sensor assembly: 0.33 × 0.2 m

Status
In service. In production.

Contractor
Geonics Limited.



The EM61HH-MK2 detector can be operated either with or without wheels (Geonics)
0125122

EM61-MK2 detector

Description
The EM61-MK2, an enhanced version of the original EM61, is a time domain metal detector designed to detect both ferrous and non-ferrous objects with excellent spatial resolution. A single 20 mm projectile can be detected to a depth greater than 0.5 m. Comparatively, for larger targets, a single 200 litre (55 gallon) drum can be detected at depths greater than 3 m. A modification for increased power, to increase both the sensitivity to smaller targets and depth of exploration is available.

Data from multiple time gates (3 or 4, user-selectable) are recorded to provide a more complete measurement of the response decay rate for improved target characterisation and discrimination. Early time gates improve the detection of smaller, as well as deeper targets; a mid-range time gate, at the same position as the EM61 time gate, offers comparison with, and continuation of original EM61 data sets.

EM61-MK2 detector in trailer mode (Geonics) 0125121

Calculation of the decay apparent time constant, proportional to the ratio between the early and late time signal responses, allows for the identification of targets with similar physical characteristics (such as material, size and shape) to improve target discrimination.

Data acquisition is supported by an Allegro CX field computer. Features include real-time graphic display of data for review and quality control; high-capacity data storage for extended survey time; increased rate of data collection; and additional input connections for simultaneous collection of EM and GPS data.

The system is GPS compatible; a fully integrated Trimble AG114, with no requirement for a separate GPS receiver console, is available as an option.

The system can be pulled as a trailer, in single or multiple unit configurations, or carried by an operator with a belt harness.

For applications in marine environments, the EM61S (Submersible) is capable of data collection to depths of 60 m below the water surface.

Specifications
Measured quantities: four time gates of secondary response in mV
EM source: air-cored coil, 1 × 0.5 m
Current waveform: unipolar rectangular current with 25% duty cycle
EM sensors
main: air-cored coil, 1 × 0.5 m, coincident with EM source
focussing: air-cored coil, 1 × 0.5 m, 0.3 m above main coil
Measuring ranges: 10,000 mV
Dynamic ranges: 18 bits
Output monitors: 16-line graphic LCD with 24 characters per line, and audio tone
Data storage: 330,000 data sets
Power supply: 12 V rechargeable battery for 4 h continuous operation
Operating weight
backpack: 8 kg
coil assembly: 14 kg
coil assembly (trailer mode): 23 kg
Dimensions
backpack: 0.6 × 0.3 × 0.2 m
coil assembly (bottom): 1 × 0.5 × 0.05 m
coil assembly (top): 1 × 0.5 × 0.02 m

Status
In service. In production.

Contractor
Geonics Limited.

EM63 detector

Description
The EM63 metal detector uses time domain electromagnetic (TDEM) methods for the detection of unexploded ordnance. Measurement of the full transient electromagnetic response is designed to offer improved detection capability and information on target characteristics.

The EM63 generates a pulsed primary magnetic field that induces eddy currents in nearly metallic objects. The decay of these eddy currents with time generates a secondary magnetic field with a specific rate of decay

EM63 detector (Geonics) 0529694

that is determined uniquely by the character (size, shape, orientation and metal composition) of the object itself.

Measurement of the secondary magnetic field decay (the transient response), provides important information towards: a more complete characterisation and classification of the target; identification and rejection of the characteristic response from certain geologic materials (such as magnetite); and consequently, a reduction in target selection error (the 'false positive rate').

The EM63 is designed to accurately measure the complete transient response over a wide dynamic range of time: measurements are recorded at 26 geometrically spaced gates, covering a time range from 180 µs to 25 ms. Data acquisition is supported by an Allegro field computer, with a 32,000 data set storage capacity, which is able to simultaneously receive GPS data for location control.

Specifications
Measured quantities: 26 time gates of secondary response in mV covering range from 180 µs to 25 ms
EM source: air-cored coil, 1 × 1 m
Current waveform: bipolar rectangular current
EM sensors
main: air-cored coil, 0.5 × 0.5 m, coincident with EM source
focussing: air-cored coil, 0.5 × 0.5 m, 0.6 m above main coil
Measuring ranges: 10,000 mV
Dynamic ranges: 18 bits
Output monitors: 16-line graphic LCD with 24 characters per line
Data storage: 32,000 data sets
Data output: RS-232 serial port
Power supply: 12 V rechargeable battery for 8 h continuous operation
Operating weight
sensor: 32 kg
console: 4.5 kg
battery: 10 kg
Dimensions
sensor: 1 × 1 × 0.6 m
console: 0.38 × 0.19 × 0.06 m
battery: 0.23 × 0.21 × 0.14 m

Status
In service. In production.

Contractor
Geonics Limited.

Super Omni hand-held metal detector

Description
The Super Omni metal detector has been designed to maximise the detection range of ferrous and non-ferrous objects in all directions, while minimising power consumption. When set at 'optimum' the Super Omni will detect a 9 mm pistol at a range of 120 mm and will operate in normal airport usage for more than 200 hours on a standard 9 V alkaline battery.

The detector has built-in audible and visible indicators to provide a quick and clear response to metal objects. It has been designed to be light, well-balanced, easy to handle and capable of being used for long periods without operator fatigue. A continuously sounding buzzer indicates when the battery needs to be replaced or recharged.

The detector casing is made of high-impact nylon and glass fibre, and is designed to fully protect the adjustable controls. The smooth cylindrical probe has been optimised for rapid search. It has no loops or sharp edges to catch on clothing and allows the operator to work further away from the target. The Super Omni will not affect cardiac pacemakers or defibrillators.

Optional built-in earphone jack, leather belt holster, rechargeable batteries and battery chargers are available.

Henotex Super Omni metal detector 0023331

Status
No longer in production. Henotex metal detectors are in service in over 80 countries worldwide.

Contractor
Henotex (1981) Inc.

SuperOmniPlus hand-held metal detector

Description
The SuperOmniPlus is a rugged, hand-held metal detector designed to detect metallic weapons and objects using a non-contact, physical screening procedure.

The detector has two user-selectable preset sensitivity levels (high and low). It is lightweight and a 9-volt alkaline battery provides more than 250 hours of normal operations (Model A and Model A-S). Three colour LEDs indicate the unit set-up and functions. Ferrous and non-ferrous metals can be detected equally from any direction. An LED visual alarm and audible signal (Model A) or a vibration motor (Model A-V) indicates the detection of metal objects. The dark grey casing is made of high impact nylon and fibreglass and the controls are fully protected. The unit does not false alarm when moved rapidly up and down.

The SuperOmniPlus is NIJ Standard-0606.02 and CE approved.

Status
In production. Henotex metal detectors are in service in over 80 countries worldwide.

SuperOmniPlus metal detector 0587890

Contractor
Henotex (1981) Inc.

For details of the latest updates to *Jane's Explosive Ordnance Disposal* online and to discover the additional information available exclusively to online subscribers please visit **jeod.janes.com**

V-920 Smartmag portable ferrous ordnance locator

Description
The V-920 Smartmag portable magnetic anomaly detector, no longer produced by Scintrex, was designed to handle a wide variety of tasks, including buried ordnance detection, archaeological investigations and engineering applications.

The system uses a 64 × 24 pixel LCD graphic screen, visible in all lighting conditions, to show graphic displays which allow the operator to quickly analyse characteristics of the survey data. The system also comes with user-friendly menu-driven software for IBM PC compatible computers which provides data processing, mapping and anomaly analysis functions.

The Smartmag has a large capacity memory expandable to 200,000 readings. Two survey modes are available: sweep mode, which provides audio feedback for large areas, and survey mode, which provides an output that is compatible with data processing programmes for graphical representation, including a 3-dimensional plotting output.

Specifications
Sensitivity: 0.01 nT
Weight (including battery pack): 8.5 kg

Status
No longer in production.

Contractor
Scintrex Trace Corporation.

China

Model 82 portable detector set

Description
Primarily designed for mine detection the Model 82 contains two separate detectors, the main set being used for minimum-metal mines and the auxiliary set for metallic mines and UXO. Both are contained in a sealed metal carrying case that is water and vibration proof. The makers claim that the main set can be immersed in water for 24 hours and still remain operational.

Both types of detector can be mounted on a telescopic aluminium pole. The detector head is shrouded in rubber and is capable of absorbing impacts equivalent to being dropped from a height of 1 m. The entire set is corrosion resistant. It is claimed that an operator can use the Model 82 after only 1 h of training using the instruction manual supplied with each set.

Specifications
Weight
main set: 3.5 kg
auxiliary set: 1.5 kg
Type of batteries:
single non-rechargeable 12 V zinc-mercury
1.5 V R20
R14
Operational temperature: –40 to +50°C

Status
In production. In service with the Chinese armed forces.

Contractor
China National Electronics Import and Export Corporation.

Shanghai Research Institute portable detectors

Description
The Shanghai Research Institute of Microwave Technology has designed five models of portable detector primarily intended for mine detection.

Model 82-G
The Model 82-G is designed to detect both metallic and minimum-metal mines. It is powered by 10 AA batteries and can remain continuously operational for up to 20 hours. The detector has a rectangular search head, with the electronics unit mounted over the carrying handle. The headphones are worn inside a 'flying-type' helmet.

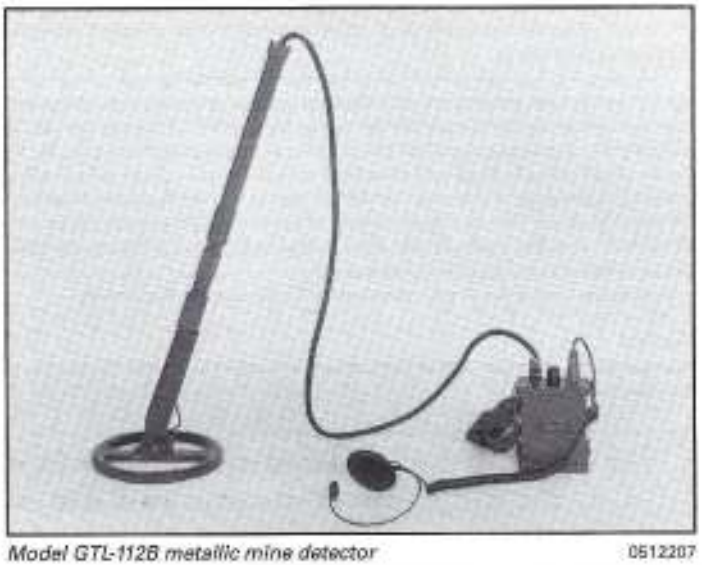
Model 120 (82 G-M)
The Model 120 can detect minimum-metal mines and has a ground rejection function for use when operating over soil with a magnetic content. The detector is powered by 10 AA batteries and can be used continuously for up to 30 hours. The search head is circular and the electronic unit is mounted to the side of the carrying handle. Headphones are worn inside a 'flying-type' helmet. This model has been in service with the People's Liberation Army since 1986.

Model GTL-112B
The Model GTL-112B is an improved version of the Model 120 mine detector and employs single-coil electromagnetic induction techniques. It is designed to reduce the number of false alarm signals resulting from background noise. Other design features include low weight, ease of operation, modular components for maintenance and repair, and ease of adjustment. The detector can operate in rain or shallow water.

Its main components are an electronics unit, a search head with telescopic handle and cable, earphones and a carrying case. The electronics unit contains the control panel, the internal printed circuit board and the battery container with 10 AA batteries; these provide an operational life of not less than 20 hours. There are two sockets on the control panel for earphones, together with an adjustable knob for controlling the power and sensitivity adjustment. The Model GTL-112B is claimed to detect a minimum-metal anti-personnel (AP) mine buried over 120 mm deep. It is in production and in service with the People's Liberation Army.

Model 85-S special-purpose detector
The Model 85-S mine detector has a small, narrow search head and it is claimed to be suitable for detecting mines with minimal metal content. It is characterised by its small size, low weight and high reliability. It has

Model 82-G mine detector
0511639



Model GTL-112B metallic mine detector 0512207

Model GTL-112B metallic mine detector in operation
0512206

a ground rejection feature to reduce the signature and false alarm rate when working in magnetic soils.

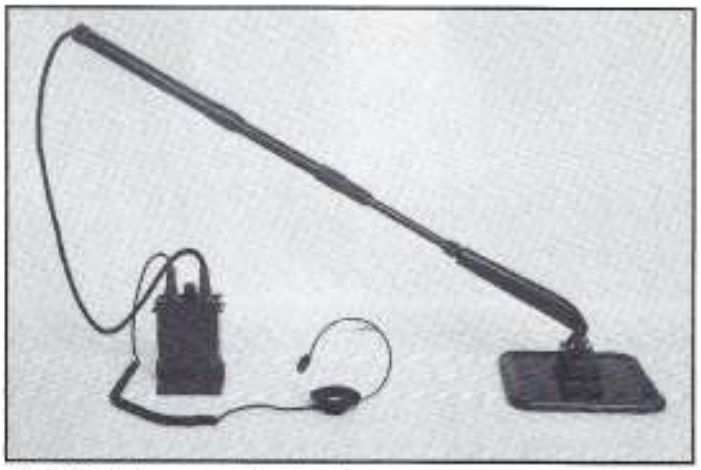
Model 90 dual-purpose detector
The Model 90 dual-use mine detector combines the functions of metallic and minimum-metal mine detection and can be used in three modes: metallic mine detector, minimum-metal mine detector or dual-use. It is designed for increased reliability and speed of operation, while also reducing the false-alarm rate. Its main components are the electronics unit, the search head with telescopic handle and cable, earphones and a carrying case. It is claimed that the Model 90 will detect a Type 72 anti-tank mine buried 80 mm deep with the search head 50 mm above the surface. For Type 72 anti-personnel mines, the figure is not less than 20 mm with the search head 50 mm above the surface. The Model 90 is in production and in service with the People's Liberation Army.

Specifications

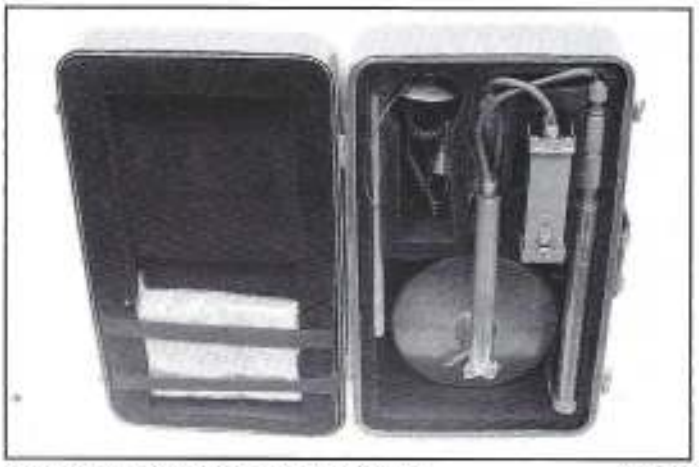
Model 82-G
Weight: <3 kg
Detecting head dimensions: 225 × 225 mm
Length of handle: 0.75–1.5 m
Range of detecting head above ground: 20 to 80 mm
Claimed detection depth with head 50 mm over ground
AT Type 72 mine: 100 mm
AP Type 72 mine: 30 mm
Operating temperature range: –40 to +55°C

Model 120
Weight: <3.7 kg
Detecting head diameter: 220 mm
Length of handle: 0.7–1.5 m

Model 90 in storage case (SRIMT)
0529587



Model 90 dual-purpose mine detector
0512208



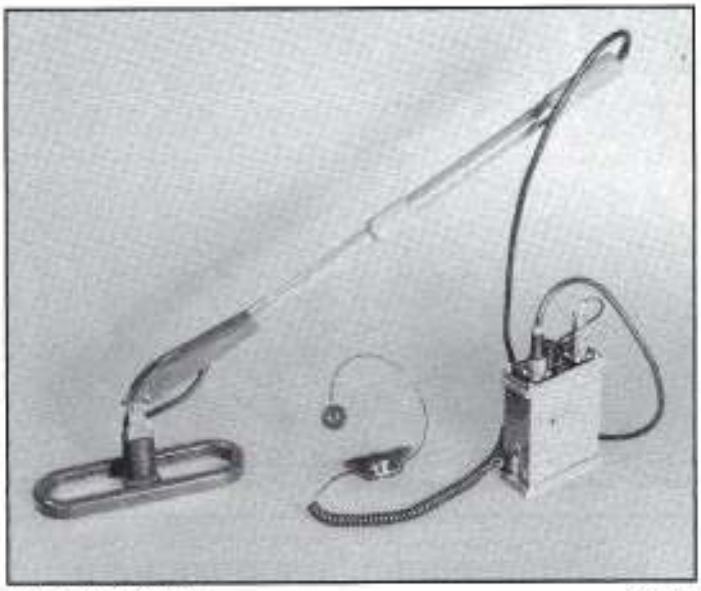
Model 120 (82 G-M) in storage case (SRIMT)
0529589

Model 120 (82 G-M) (SRIMT)
0529588

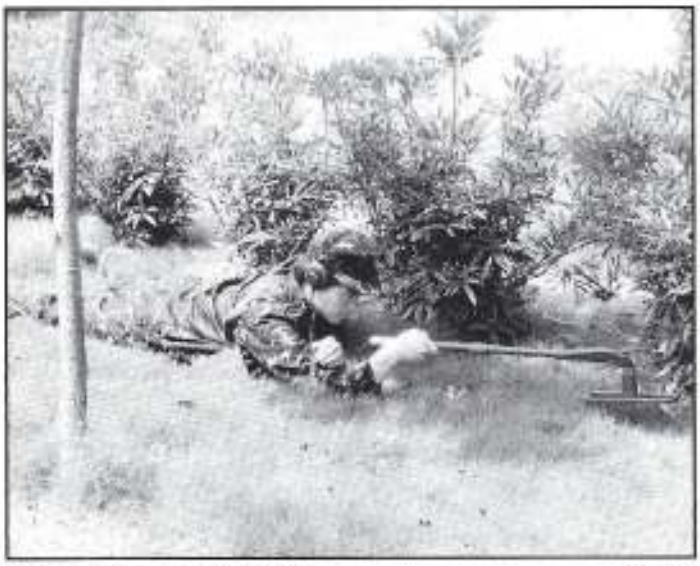
Detection sensitivity
C3A1 mine: not less than 140 mm
AP Type 72: not less than 100 mm
Operating temperature range: –40 to +55°C

Model GTL-112B
Weight: <2.5 kg
Weight of empty carrying case: 4 kg
Search head diameter: 210 mm
Telescopic handle length: 0.7–1.5 m
Detection sensitivity
C3A1 mine: not less than 120 mm
AP Type 72: not less than 100 mm
Operating temperature range: –40 to +55°C

Model 85-S
Weight: <2 kg
Detecting head dimensions: 54 × 220 mm



Model 85-S (SRIMT) 0529591



Model 85-S in operation (SRIMT) 0529590

Detection sensitivity
C3A1 mine: not less than 80 mm
AP Type 72: not less than 70 mm
Operating temperature range: –40 to +55°C

Model 90
Weight: 3.5 kg
Search head dimensions: 255 × 255 mm
Telescopic handle length: 0.7–1.5 m

Battery life: ≥8 h
Operating temperature range: –40 to +55°C

Status
In production. In service with the People's Liberation Army.

Contractor
Shanghai Research Institute of Microwave Technology.

Czech Republic

Explorer TM-93 and TM-D metal detectors

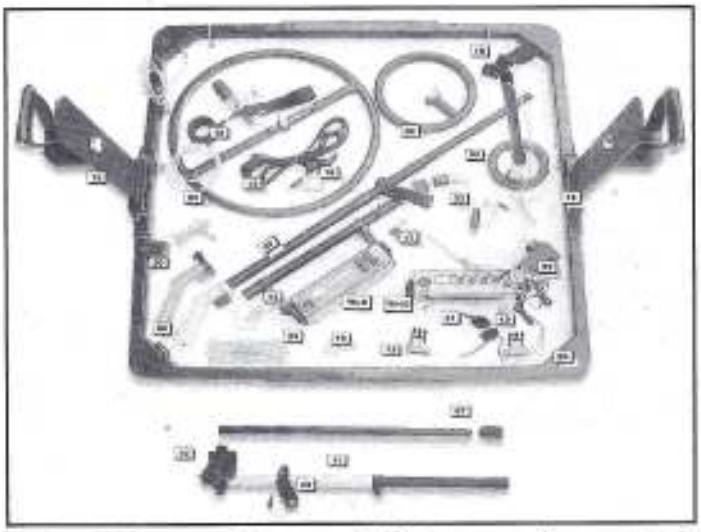
Description
The Explorer TM-93 and TM-D are portable pulse induction detectors designed to detect electrically conductive (ferrous and nonferrous) materials buried in the ground. The TM-D shares the same features as the TM-93, but has an enhanced target discrimination capability.

Specifications
Standard coils: 130, 240 and 500 mm diameter
Extra coil: 1 × 1 m
Power supply: 12 V/2 Ah sealed lead-acid battery
Temperature range: –15 to +40°C

Status
In production. In service in the Philippines, Thailand, United Kingdom and United States.

Contractor
Geoinstruments.

Marketing Agency:
CZ Team Limited.



Explorer TM Detectors with accessories (Geoinstruments) 0529568

Explorer TM pulse-induction metal detectors

Description
The Explorer TM range of high-sensitivity metal detectors is designed for the detection and dimensional discrimination of magnetic and electrically conductive non-magnetic targets buried in ground or shallow water. It uses a pulse-induction detection method that enables disturbance suppression and enhanced target discrimination by computer-assisted analysis of the coil signal without the need to keep the coil in motion. This allows the use of very large coils for high depth penetration.

The detectors are powered by a sealed lead-acid rechargeable battery with built-in automatic charger.

The Explorer TM-D model features enhanced target discrimination. This is achieved by analysing the decay rate of the coil signal, which gives information about the target size and conductance, without being affected by signal strength.

Status
In production.

Contractor
Omnipol as.

PMG-1 portable proton gradiometer

Description
The PMG-1 proton gradiometer is a portable microprocessor-based magnetometer with a resolution of 0.1 nT (gamma). The detector can be used in three modes:

- **Single mode:** providing measurement of total-field vector by one sensor in profile survey applications
- **Grad mode:** using two spaced sensors to simultaneously measure total-field vector and calculate the gradient (horizontal or vertical) between sensors

• **Auto mode:** the PMG-1 can be used as a base station, with selectable sample rates and stored readings.

Standard components of the PMG1 are processing unit; two sensors; battery charger; foot, middle and gradient sticks; anchor ring with ropes; tent pins; harness; instruction manual; disk with communication and transport case.

Specifications

Dimensions:
console 240 × 90 × 200 mm
sensor Dia 80 × 200 mm
Weight:
console 3.5 kg including battery 12 V/3.4 Ah
sensor 0.7 kg
Operating temperature: –10°C to +60°C
Field strength range: 20,000–100,000 nT (gammas)
Resolution: 0.1 nT
Gradient range: 1,000 nT/m
Measurement time: 2 seconds
Data memory: Internal RAM for 18,000 readings
Data storage time: over the lifetime of the lithium battery (ca 10 years)
Display: LCD, 2 × 16 characters, back-light
Interface: RS-232C serial channel
300 to 9,600 Baud rate (selectable)
10 bits, 1 start, 8 data bits (no parity)
Power source: Internal lead-acid (Pb) battery 12V/3.4Ah
Battery life: 5,000 readings on average in GRAD operation

Status

In production.

Contractor

SatisGeo, s.r.o.

France

Model F1

Description

The Model F1 was designed for detecting minimum-metal Anti-Tank (AT) and Anti-Personnel (AP) mines. The complete detector is packed into a case 655 mm long, 320 mm wide and 160 mm high, which has two foam packing pieces to protect the equipment from vibration. The complete detector can be assembled for use in less than 5 minutes.

The Model F1 consists of five major components: the detecting head; telescopic handle; electronics box; connecting cable; a set of standard dry batteries. The batteries provide sufficient power for up to 30 hours of continuous use. Accessories include a flexible cover for the detection head and a headset with cable and connector. The former is fitted to the detection head when the terrain has fluctuating temperatures, for example shaded and sunlit areas.

The detector can be used in either the standing or the prone position. When standing, the telescopic handle is extended and the angle of the search head on the handle is adjusted, enabling the operator to sweep the head in front of him from side to side as he moves forward. For the prone position, the sweep motion is similar but the operator lies on the ground with the handle and the head parallel to the ground.

Specifications

Weight ready for use: 3.5 kg
Dimensions: 650 × 300 × 155 mm

Metallic mine detector Model F1 0511641

Operational life of batteries: 30 h (continuous)
Operating temperature range: –31.5 to +51°C

Detection capability	Detection range
1 g of steel	100 mm
20 g of aluminium	300 mm
100 g of aluminium	450 mm

Status

No longer in production.

Contractor

Nexter.

Germany

Ebinger data recording and processing systems

Description

Ebinger's 96 series datalogger systems enable the operator to record, digitalise and store measurement data as a mobile unit. The single channel and 3-channel versions are not only suitable for small areas, but also as a longer distance mobile unit that can be carried by one person. On larger open spaces a maximum of 32 channels (sensors) towed behind a vehicle can be stored. This enables the operator to cover large areas in a short time, with sufficient density of measurement points to successfully detect contamination.

The dataloggers can be adapted to work with different kinds of sensor equipment. All dataloggers from the 98 series have a built-in power supply to provide external voltage for adapted sensor equipment, reducing the amount of component parts needed.

DLM-93 Standard single and 3-channel version used for normal groundwork and in boreholes. Using a data measurement interval of 100 mm it is possible to record up to 50 km of data at one time.

DLM-98 Improved version with a backlit alphanumeric graphic display. The keyboard has been modified to allow input of many kinds of data and the transfer of measurement values to a PC system has been speeded up.

DLM-98GPS Enables the user to record data values and simultaneously store the ground co-ordinates.

DLM-98BM Developed along with its own software for data recording in boreholes. This system allows measurement values to be read while they are being recorded, allowing measurements to be previewed online. This system can optionally be connected to a DGPS system to also record accurate borehole co-ordinates.

DLMX-93 A multichannel system with up to 8 channels suitable for use with vehicle-towed sensors. Recorded data is automatically transferred to an online PC in the vehicle.

DLMX-98 An improved version of the DLMX-93 capable of simultaneously recording data from up to 32 sensors.

DLM-98 (Ebinger) 1041080

Status

In production.

Contractor

Ebinger Prüf- und Ortungstechnik GmbH.

SECTION 4

Ebinger EB 420 H detector

Description

The hand-held metal detector EB 420 H is a development of the EB 420 and was designed with the HALO Trust (see separate entry) to support their One-Man-One-Lane (OMOL) drill in mine clearance. It is a single-piece tool without external boxes or cables.

The EB 420 H is designed to detect unexploded ordnance and minimum-metal mines with minimal operator fatigue and enhanced safety precautions. It is designed as a lightweight and easy to use tool for use by operators without advanced training and is suitable for use in difficult terrain. The EB 420 H is operated by one control knob and automatically adapts through its dynamic search mode to homogenous background interference. The detector uses the Ebinger sine wave system and detects metal components, including wires, by an electromagnetic field of low frequency. The manufacturer claims that the detector can achieve a good resolution of several mines buried adjacent to each other or to other interfering metal. A solar powered version is also available.

EB 420 H solar (Ebinger) 1041246

The EB 420 H was developed in conjunction with the HALO Trust (Ebinger) 1041245

Specifications

Power supply: 1× 9 V dry battery U9VL or L61 or rechargeable version
Operating time
dry battery: 45 h
LR61: 20 h
Ni-MH battery: 8 h
Operating temperature: +20 to +55°C
Search head dimensions: 200 mm or 260 × 156 mm
Length
short version: 0.9 m
long version: 1.6 m
Weight
short version: 0.9 kg
long version: 1.3 kg

Status

In production. In service in 29 countries including Afghanistan, Angola, Cambodia, Guatemala, Iraq, Kuwait, Lebanon, Mozambique, Nicaragua and Somalia.

Contractor

Ebinger Prüf- und Ortungstechnik GmbH.

Ebinger EBEX® 410 Combination search equipment

Description

This versatile search equipment can be used in many different combinations to suit a wide range of search applications, including a hand-held detector with search coil, cylindrical probe or a large-scale detector unit for use on open ground.

The system makes use of the very sensitive damping principle; the search head is part of the oscillating circuit which, when brought near metal, undergoes a withdrawal of energy. The oscillation amplitude is reduced and this is transduced into an audible alarm signal.

The unit is operated with one rotary switch controlling the detection threshold and power. The detector automatically adjusts to the prevailing electrical ground conditions. Short control pulses indicate operational readiness and also monitor battery voltage.

The system comprises: an electronic cylinder, carrying and extension rod, 145 mm search coil, 260 mm search coil, cylindrical probe, extension cable, headphones, piezo buzzer, rechargeable Ni-Cd battery charger unit and carrying case.

Specifications

Coil diameter: 145 or 260 mm
Operating time
Ni-MH rechargeable battery: 8 h (approximate)
dry battery: 20 to 25 h (approximate)
Operating temperature: –10 to +50°C
Weight: 0.8 to 1.2 kg depending on version
Weight in transit case: 6.8 kg
Case dimensions: 460 × 350 × 175 mm
Power supply: 9 V dry battery IEC 6 F 22 or Ni-MH rechargeable

Status

In production and in service.

Contractor

Ebinger Prüf- und Ortungstechnik GmbH.

EBEX® 410 components in transit case (SDS Group Ltd) 0074396

Ebinger EBEX® 420 PB/D metal/mine detectors

Description

The EBEX® 420 PB/D metal detectors were designed for the location of mines, including those with minimum-metal content, and unexploded ordnance buried underground or in shallow water in theatres with reduced logistical capabilities.

The detector is designed as a modular piece of equipment and there are no connection cables between the operator and the device.

The EBEX® 420 can be operated in a short or a long mode to search either in the prone position, or standing upright. The detector's audio dynamics assists with the initial classification of detected targets. The electronics unit 'learns' about the changing electric search conditions of the soil, temperature and moisture and adjusts automatically for maximum safety and efficiency.

Specifications

Power supply: 6 × 1.5 LR14 C-cell batteries (or rechargeable version)
Operating time (at +20°C)
alkaline battery: 55 h
rechargeable: 30 h (approximate)
Temperature range: –30 to +60°C
Standard dimensions
oval search head: 260 × 156 mm
short version: 1 m (approximate)
long version: 1.6 m
Weight
short version: 2.1 kg
long version: 2.3 kg
packed in carrying case with accessories: 8.3 kg

Status

In production and in service.

The EBEX® 420 PB/D detector is designed for use in theatres with limited logistical support (Ebinger) 1041247

Contractor

Ebinger Prüf- und Ortungstechnik GmbH.

Ebinger EBEX® 421 GC (Ground Compensation) detector

Description

The 421 GC (Ground Compensation) detector uses the pulse induction operating principle to detect minimum-metal objects at operational depths in non-homogeneous and mineralised soils such as magnetite, laterite, bauxite and where conductivity has been affected by monsoon rain. It also filters interference from salt water.

With similar construction characteristics to the 420 (see separate entry), it is easy to handle and the modular design allows for ease of maintenance. The detector comprises: an oval search head, extension rod, electronics/control module and battery container. It is supplied complete with a headset, test piece, soft carry case and storage case.

The factory setting compensates for almost all types of conductive soils; the operator can additionally tune the detector to adapt to unusual conditions. Its effective false alarm cancellation and the simplicity of operation through just one control knob make it ideal for use in adverse conditions and by non-technical operators. The detector can be used in the lying, kneeling or standing position.

Accessories include: probe sensor (30 × 290 mm), enlarged search head for deep search (280 × 400 mm), handgrip, armrest and loudspeaker.

Specifications

Power supply: 8 dry 1.5 V C-cells (LR 14 C) or 8 × 1.2 V 3.5 Ah Ni-MH rechargeable batteries
Operating time (20°C)
dry battery: 20 h
Ni-MH: 12 h
C-cell LR 14: 40 h
Operating temperature: –30 to +55°C
Dimensions
search head: 230 mm
short detector version: 1 m (approx)
long detector version: 1.6 m (approx)
Weight
short detector version: 2.1 kg (approx)
long detector version: 2.4 kg (approx)
complete in transit case: 8.5 kg (approx)

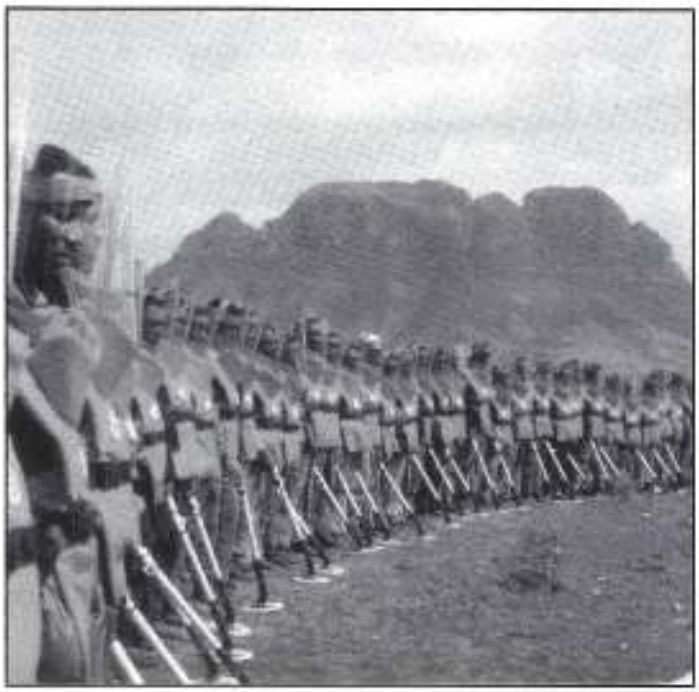
Status

In production.

Contractor

Ebinger Prüf- und Ortungstechnik GmbH.

EBEX® 421 GC components (Ebinger) 1041243



The EBEX® 421 GC is widely used in support of humanitarian clearance operations (Ebinger) 1041244

Ebinger EBEX®535 metal detector

Description
The EBEX®535 was designed for the detection and pinpoint location of ordnance, mines, improvised explosive devices and weapons. It also detects minimum metal components in mine fuzes or in booby traps.

The detector search head sends out electromagnetic pulses of special shape and intensity to generate magnetic responses in metal targets. Two receiver loops inside the search head detect any unequal induction from the response signal. Due to the differential effect of the search head most interference, such as that from mineralisation, conductivity or salt water, will be suppressed within wide limits.

The presence of metal objects is indicated by a dual audio signal. The precise object centre is indicated by the change in audio signal between low and high frequency and the device can be used in areas with strong interference.

The EBEX ® 535 offers three sensitivity settings and two search modes: static or dynamic. In the dynamic mode the device will automatically compensate and adapt to the electrical surroundings of the search head; in static mode any electrical difference will generate a static signal.

Specifications
Operation time (at +20°C): 50 h (approximate)
Weight
complete: 3.5 kg
in transit bag: 5.0 kg
in storage case: 9.0 kg
Search head
oval: 260 × 156 mm or 300 × 170 mm
halo: 260 mm diameter
Length: 960 to 2,015 mm
Operating temperature: –30 to +70°C
Power supply: 6 × 1.5 V C cell alkaline batteries

Status
In service but no longer in production.

Contractor
Ebinger Prüf- und Ortungstechnik GmbH.

Ebinger EBEX 600 series of hand-held detectors

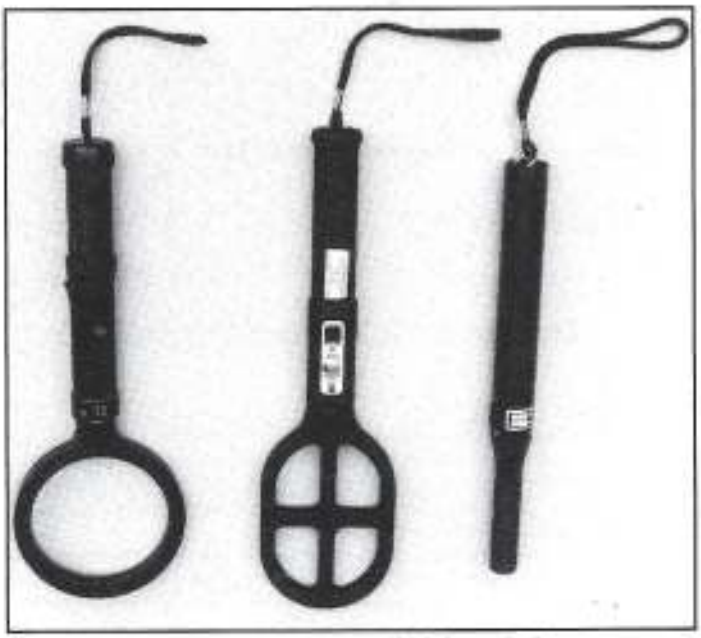
Development
These hand-held scanners are used to screen persons for metal objects such as Improved Explosive Devices (IED) components, slashing weapons, knives or pistols.

Description
The 600 series is lightweight, but made of robust synthetic materials. The detectors are designed to be comfortable to handle and easy to operate.

Audio and LED pulses indicate readiness for operation and battery capacity. The detectors calibrate automatically to a preset sensitivity; this can be adjusted as required. The battery compartment is integrated into the handle, which also contains a spare battery and the potted PC-board. Accessories include rechargeable battery, charger, ear/headphone and canvas transit bag.

The detector does not affect heart pacemakers and magnetic recording material.

Specifications
Power supply: 9 V dry battery PP3 or rechargeable NiMH-battery
Operating time
dry battery: approx 30–40 h
NiMH battery: 20–25 h
Weight: 440 g
Length: 420 mm
Search head diameter: 145 mm
Handle diameter: 37 mm
Temperature range: –10 to +55°C
Detection ranges
9 mm cartridge: approx 100 mm
1DM coin: approx 150 mm
Metal plate (50 × 50 × 1 mm): approx 200 mm
Pistol/hand grenade: approx 300 mm



EBEX 600 series of hand-held detectors (SDS Group Ltd) 0074321

Status
Available.

Contractor
Ebinger Prüf- und Ortungstechnik GmbH.

Ebinger EBEX ® 610C and 610D detectors

Description
Based on the 600 series (see separate entry), the 610C has a cloverleaf search head. The airport version is a sealed unit with external battery charger, while the standard version operates on commercial dry batteries or on a rechargeable battery. The detection dynamic operation mode compensates for strong electrical interference from outside and strong detection signals cause the detector to switch to a static operation mode, showing metal without detector movement.

The 610D is the latest development and provides a 'tremolo' tone for detecting different metals in close proximity – for example, it will detect a blade behind a metal buckle or a metal object hidden in the sole of a shoe when standing on a metal deck.

Specifications
Power supply: 9 V E-block dry battery IEC 6LR61 (611) or PP3 style rechargeable battery
Operation time
dry battery: 35 h
rechargeable battery: 10–15 h
Charging time: 5–6 h (approximate)
Length: 420 mm
Search head: 170 × 115 mm
Handle diameter: 32 mm
Weight: 275 g (approximate)
Temperature range: –20 to +55°C

EB-610C (Ebinger) 1041081

Status
In service. In production.

Contractor
Ebinger Prüf- und Ortungstechnik GmbH.

Ebinger MAGNEX® 105 magnetometer

Description
The MAGNEX® 105 detects magnetic anomalies in the earth's magnetic field caused by ferromagnetic objects. Detection is signalled by an audio signal that increases in frequency as the target is approached and indicates the field polarity (north/south) of the anomaly by a pulsating or continuous alarm. Indication of the field polarity is needed to distinguish vertically buried objects such as valves or magnetic underground markers from other signals.

The limits of detection range are dependent on size and position, as well as the magnetic signature of the objects to be detected. The magnetometer is supplied with an earpiece, rechargeable battery and plug-in battery charger.

Specifications
Power supply: 9V PP3 or its rechargeable version
Operating time (20°C):
alkaline battery: 20 h
rechargeable battery: 6 h
Operating temperature: –20 to +55°C (approximate)
Sensitivity threshold: 40 nT (approximate)
Dimensions
probe Ø: 35 mm
length: 1,050 mm
Weight: 1 kg (approximate)

Status
In production and in service.

Contractor
Ebinger Prüf- und Ortungstechnik GmbH.

MAGNEX® 105 magnetometer
(Ebinger)
1041241

Ebinger MAGNEX® 120 LW magnetometer

Description
The MAGNEX® 120 LW was developed for bomb disposal and explosive ordnance disposal (EOD) and in particular for the location of ferromagnetic munitions buried underground or on the seabed. The locator can be used for land, water and borehole inspection.

The MAGNEX® 120 LW works on the gradiometer principle, detecting geomagnetic field interference. Objects made from ferromagnetic material can show a magnetic field which superimposes onto the natural terrestrial field. The amplitude and polarity of the local anomaly are used to indicate the position of unexploded ordnance.

Specifications
Sensitivity: 10 to 3,000 nT (approximate)
Operating temperature: –20 to +55°C
Weight (assembled): 4.2 kg (approximate)
Operating time: 50 h at 20°C (approximate)
Power supply: 6 × 1.5 V LR20 cells

Status
In production and in service.

Contractor
Ebinger Prüf- und Ortungstechnik GmbH.

MAGNEX® 120 LW magnetometer
(Ebinger)
1041252

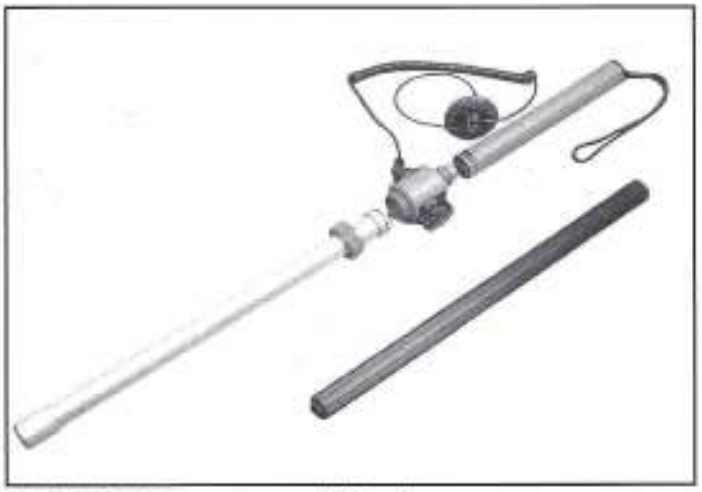
Ebinger MAGNEX® 130 B magnetometer

Description

MAGNEX® 130 B is used to locate ferromagnetic objects buried underwater and on the seabed. Typical targets include bombs, shells, mortars, sea mines, parts from ships or entire wrecks.

The detector is a passive iron locator, which detects and indicates local anomalies in the natural magnetic field of the earth. It applies the same passive-differential field strength detection principles as the bomb locators for land use.

The MAGNEX® 130 B magnetometer can be used underwater (Ebinger) 1041250



MAGNEX® 130 B magnetometer (Ebinger) 1041251

The MAGNEX® 130 B has three sensitivity ranges. In range 1 the magnetometer operates in a dynamic detection mode, in range 2 in a semi-static mode and in range 3 in a static mode. In ranges 1 and 2 the device automatically adjusts itself and does not require any further calibration or adjustment procedures. The static mode offers the largest detection range, which is dependent on the magnetic signature of the target object.

Specifications

Length: 960 mm
Diameter: 62 mm
Weight: 1.5 kg
Sensitivity (static mode): 35 nT (approximate)
Operation time: 6 h (approximate)
Charging time: 14 h with 15 mA
Field polarity indication: pulsating/continuous tone
Power supply: 9 V block PP3 Ni-MH rechargeable battery

Status

In production and in service.

Contractor

Ebinger Prüf- und Ortungstechnik GmbH.

Ebinger TREX® 150 active bomb detector

Description

Ebinger's TREX® (Transmitter Receiver Explorer) system is an active metal detector intended to be primarily used to locate large metal objects such as underground deposits, barrels, or bombs and large UXO.

Distinctive features of the system include its selectivity of small metal parts on the surface and its relatively long range detection of correspondingly large objects (the transmitter effect). Depending on the size of the small objects near the surface, they are either ignored, or recognised and displayed as small parts (the absorber effect). The TREX® system therefore supplements standard passive magnetometer technology.

Specifications

Power supply: Ni-MH battery 12 V, 2.0 Ah
Operating time (20°C): >4 h
Operating temperature: –10 to +40°C
No of sensor levels: 5
Dimensions
overall: 1,500 × 420 × 210 mm
oval coils: 420 × 280 mm
Weight: 3.1 kg (approximate)

Status

In production and in service.

Contractor

Ebinger Prüf- und Ortungstechnik GmbH.

TREX® 150 active bomb detector (Ebinger) 1041242

Ebinger UPEX® 728 metal detector

Description

The UPEX® 728 is a highly sensitive, deep-reaching pulse induction system with soil compensation for professional applications. It is designed to detect deeply buried objects that can only be reached with difficulty using lightweight excavation tools.

A PA-function analyses the object's specific signature, which is registered both optically and acoustically. A special version with enlarged search heads and a switchable search mode is available for UXO location.

Specifications

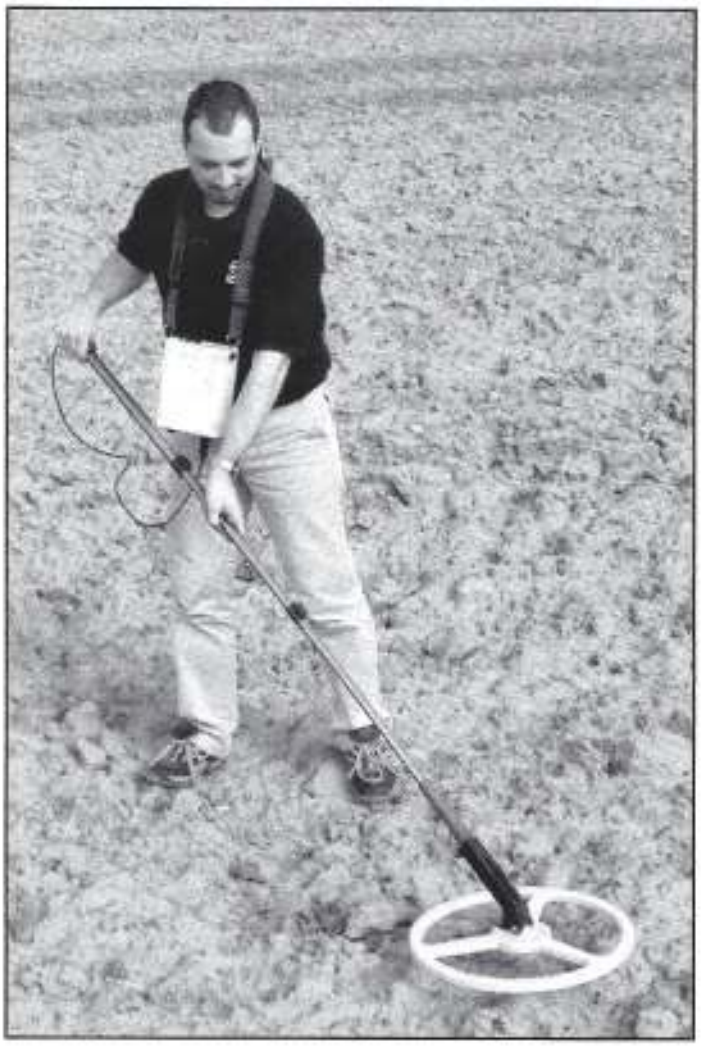
Power supply: internal 12 V/1,3 Ah PB battery, external power supply possible
Operating time: 7 to 8 h (approximate)
Dimensions
standard search loop Ø: 225 cm
ring probe Ø: 450 mm
electronics unit: 157 × 62 × 199 mm
Weight (approximate):
detection frame: 2.5 kg
electronics unit: 1.4 kg

Status

In production and in service.

Contractor

Ebinger Prüf- und Ortungstechnik GmbH.



UPEX® 728 metal detector (Ebinger)
1041240

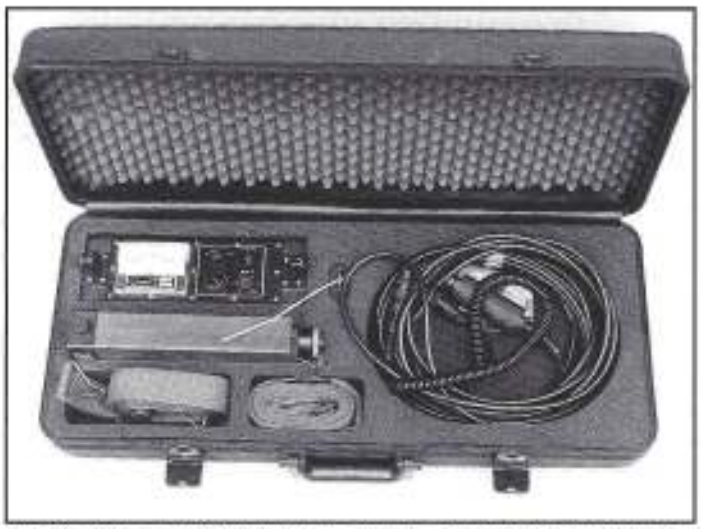
Ebinger UPEX® 740M large loop metal detector

Description

The UPEX® 740M is designed to be as easy to use as a conventional metal detector: detection signals are easy to interpret and no advanced training is required for operators. The system applies the eddy current pulse induction principle for the detection of metal components on unexploded ordnance (UXO). It can be adjusted to compensate for various types of adverse soils and to suppress surface-bound small fragmentation.

The electronics unit is compact, lightweight and splash waterproof. Target acquisition is indicated by audio alarm and by galvanometer reading. Detection results can be stored in a datalogger for plotting or further processing by software. Different indication characteristics can be selected to suit adverse working conditions.

The UPEX® 740M is also available for underwater use or with vehicles.



UPEX® 740M coil, electronics box, carrying strap and battery charger in aluminium transit case (Ebinger)
0074405

Specifications

Dimensions
electronics unit: 270 × 90 × 70 mm
search loop diameter: 2.55 m
battery container: 290 × 105 × 50 mm
Weight
electronics box: 0.9 kg
frame: 2.5 kg
battery container: 1.1 kg
Power supply: 8 × 1.5 V dry batteries LR14 C-cell or 1.2 V 2.8 Ah Ni-MH rechargeable batteries
Operating time
dry batteries: 25–55 h
Ni-MH batteries: 17–35 h

Status

In production and in service.

Contractor

Ebinger Prüf- und Ortungstechnik GmbH.

UPEX® 740M in use (Ebinger)
1041248

Ebinger UWEX® 725PA metal detector

Description
The UWEX® 725PA is a development of the UWEX® 722 which has been in service with many government departments in Europe. It operates on a pulse induction method that provides detailed information on detected objects by audio signal. The Pulse Analysing (PA) system evaluates the response signals from located objects in relation to their decay and characteristic shapes.

Small objects with short response signals will cause a continuous indication in the headset. Large objects or targets with high conductivity will cause additional pulses, which are indicated in the headset and on the LED display.

The PA system allows the detector to be used in interfering adverse conditions such as laterite soils or in the vicinity of ceramic material. Although the interference may cause numerous false alarms, the tremolo signal will still clearly indicate objects with high conductivity, despite interference from the ground or close objects of lower conductivity.

A tremolo signal superimposed on the indication signal enables the operator to anticipate target size, depth and the kind of material detected from the audio signature and its precise location.

Specifications
Detection ranges (depending on local conditions)
- 0.5 g of bronze: 100 mm (approximate)
- 20 × 50 mm steel cylinder: 300 mm (approximate)
- 200 mm metal ring: 600 mm (approximate)
- 200 × 300 × 80 mm metal box: 750 mm (approximate)

Weight (on land): 1.7 kg (approximate)
Search head: 200 × 200 mm
Electronics cylinder: 440 mm long × 40 mm diameter
Extension rod length: 600 mm
Total length: 750 to 1,350 mm
Operating temperature: –20 to +55°C
Operation time: 20 h (U9VL), 8 h (GLRG1) (approximate)
Power supply: 1 × 9 V dry battery U9VL lithium or 9 V PP3 GLRG1 alkaline

UWEX® 725 waterproof detector (Ebinger)
1041253

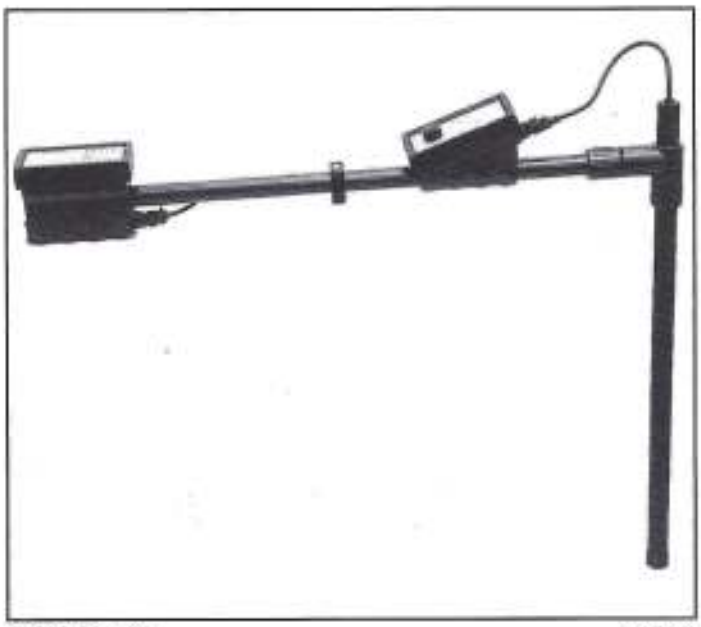
Status
In production and in service.

Contractor
Ebinger Prüf- und Ortungstechnik GmbH.

FEREX 2000 SL Detection Gradient Magnetometer

Description
Based on FEREX 4.021/Mk 26 sensor technology, Foerster's FEREX 2000 SL was approved by the US Army, British and German authorities for the environmental clean-up of ordnance and explosive waste. It was used for all conventional search operations on land, in boreholes, and underwater. Now no longer in production, the instrument was available in different packages, one being the microprocessor-aided magnetic measurement data collection system FEREX 2000SL-DLG. A data transmission cable allowed connection to a personal computer and the evaluation software DATALINE running under Windows 3.1, Windows 95™ and Windows NT™ (see separate entry). Various types of FEREX probe were available for both hand-held and vehicle-mounted search systems.

Light, waterproof and easily assembled, the FEREX 2000 SL could be fitted with either a conventional analogue meter or a liquid crystal display. It was claimed to achieve higher search sensitivity by using larger sensor spacing. An additional digital/analogue multifunction display for borehole and underwater searches was also available. Four standard cells provide power and a light case was provided for transport and storage.



FEREX 2000 SL 0512356

Status
No longer in production.

Contractor
Institut Dr Föerster GmbH and Co KG.

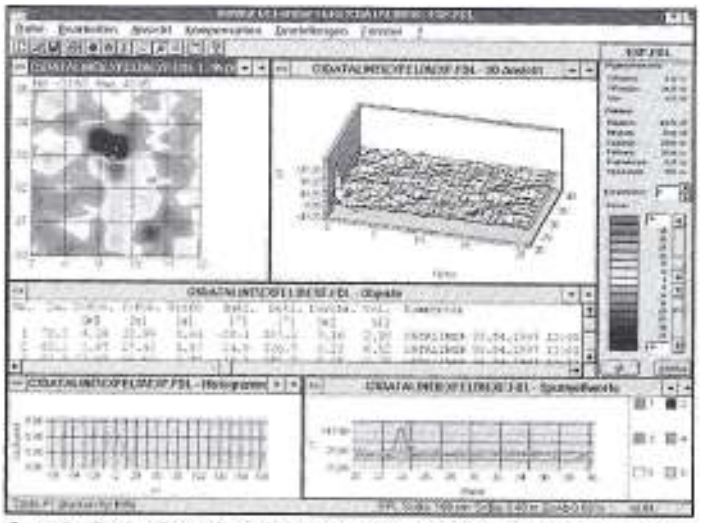
FEREX 4.021/Mk 26 Datalogger Upgrade DATALINE

Description
This system allows existing FEREX 4.021/Mk 26 detectors to be upgraded to advanced magnetometer scanning and evaluation standards. The upgrade is easy to incorporate and increases the use and efficiency of the instruments by providing object localisation, object data calculation and mapping for large area clean-up and remediation processes.

The system upgrade components comprise: a FEREX 4.021/Mk 26 control unit with additional datalogger interface; DLG 4.021 datalogger; DATALINE software; and a PC workstation or laptop computer. Precise object localisation within a co-ordinates system (selected by the customer) is made possible by a GPS connector (available upon request).

Specifications
Weight (DLG 4.021 Datalogger): 0.5 kg
Operating temperature: –20 to +55°C
Storage temperature: –40 to +70°C
Enclosure: IP65
LCD display: Graphic with high resolution and high readability
Interface: RS-232, RS-485 and GPS Input
Memory capacity: 16 Mbyte RAM or per customers' requirements
Data logging: 4 data logging channels (max 4 FEREX probes)
Max total track length: 50 km
Recording speed: max 20 data points
Data storage: 18 Bit
Dialogue language: German, English (others upon request)

FEREX 4.021/Mk26 with datalogger (Föerster) 0056053



Sample display from the DATALINE software package (Föerster) 0038479

Datalogger front panel (Föerster) 0022721

Status
No longer in production.

Contractor
Institut Dr Föerster GmbH and Co KG.

FEREX 4.021 Metal Detector

Description
The Föerster FEREX 4.021 was designed for the detection and exact location of ferromagnetic objects such as unexploded bombs, pipes, cables and so on. Large objects can be detected to depths of up to 6 m.

FEREX 4.021 Model L in use 0021481

The FEREX 4.021 meets military standards of construction and operation, using lightweight and splash-proof components; the probe is watertight to a depth of 100 m. The instrument uses 1.5 V standard cells for the power supply and has built-in functional test and auto-zero compensation.

The detector has three basic components: control unit, power supply and probe. Depending on the application, three versions of the FEREX 4.021 can be assembled using the basic components with additional accessories. These are:

FEREX K: the complete system for land, underwater and borehole applications.

FEREX L: for searching, locating and measuring on land.

FEREX W: for underwater and borehole use.

The FEREX 4.021 has now been succeeded by the later model FEREX 4.032 (see separate entry).

Specifications
Weight of L version complete: 5.5 kg
Weight of basic components: 3.8 kg
Dimensions of transit case: 1.12 × 0.175 × 0.31 m
Operating voltage: 6–12 V
Batteries: 6 × 1.5 V (IEC R 20)
Sensitivity range: 0.3–10,000 nT (8 steps)
Operating temperature range: –30 to +65°C
Probe underwater limit: 100 m

Status
No longer in production. Has seen service with the US Navy, British Army, Canadian, Danish and other NATO armed forces, the Australian and Singapore armies, and several other undisclosed countries.

Contractor
Institut Dr Föerster GmbH and Co KG.

FEREX 4.032 datalogger (DLG STD and DLG-GPS)

Description

Based on FEREX 4.021/Mk 26 sensor technology which was approved by the US Army, British and German authorities for the clean-up of ordnance and explosive waste, the Föerster detection gradient magnetometer Ferex 4.032 datalogger DLG is a modified form of the FEREX 4.032 (see separate entry in this section).

The modification involves a simple change of the 4.032 basic control box, to one that combines the API capability with a 4-channel datalogger (DLG). Once the information from the DLG has been loaded onto a PC, object data calculation and mapping for large area clean-up and remediation processes becomes possible.

Probe arrangements with up to four Föerster probes can be used in hand-held search operations for high-resolution datalogging applications. The storage capacity of the system collects trackwise magnetic field datapoints of up to 50 km in length. The collected data are easily transmitted via an interface to a PC or notebook computer.

As well as the 4.032 FEREX DLG STD, precise object localisation within a co-ordinates system selected by the customer is possible using connection to GPS through the FEREX DLG GPS model. Use of a navigation system can ensure that all of the search area is scanned. GPS co-ordinate data are assigned to the probe's measured values allowing any track to be chosen: the size of the field being limited only by the available memory capacity.

The Windows-based interactive evaluation software, FEREX DATALINE, which can be used with the 4.032 dataloggers, is compatible with Windows 95, Windows 98, Windows NT, Windows 2000 and Windows XP. Showing the position of scanned objects, DATALINE allows accurate evaluation, creating colour-coded magnetic anomaly maps, object lists and true-to-scale object maps.

The datalogger version can also be configured as a normal search instrument without its datalogging function.

Specifications

Weight: approx 4 kg with one probe
Operating temperature: –35 to +70°C
Storage temperature: –57 to +70°C
Enclosure: IP65
LCD display: graphic with high resolution and high readability
Interface: RS-232, RS-485 and GPS input
Memory capacity: 20 Mbyte RAM or per customers' requirements
Datalogging: 4 datalogging channels (max 4 FEREX probes)
Max total track length: 50 km
Recording speed: max 20 data points/s
Data storage: 20 bit
Dialogue language: German, English (others upon request)
Military standards
environment tests: MIL-STD 810E
EMC tests: MIL-STD 461D

Status

In production.

Contractor

Institut Dr Föerster GmbH and Co KG.

FEREX 4.032 DLG-GPS with 3-probe antler (Föerster) 0568687

Data transfer from FEREX DLG allowing immediate evaluation using FEREX DATALINE (Föerster) 0074212

FEREX 4.032 metal detector

Description

The FEREX 4.032 is a rugged, lightweight and easy to operate search instrument which uses a differential magnetometer with large sensor spacing for higher sensitivity. Replacing the FEREX 4.021 (see separate entry in this section), it is easy to assemble and the components meet military standards (MIL-STD 810E and MIL-STD 461D). The probe is watertight and is lifetime-calibrated. The instrument can be configured either as a land search version for borehole or underwater search and, under favourable conditions, detect mines buried as deep as 2 m.

The measured magnetic field is displayed either on a point meter (API) or a liquid crystal display. A datalogger (DLG) can be used as an alternative to signal display, with a maximum of four parallel probes. The instrument has a self-test and auto-zero compensation function.

The standard API version of the FEREX 4.032 indicates the presence of ferromagnetic objects by way of sound and the indication of a pointer instrument. Two datalogger (DLG) versions of the instrument are also available, the DLG GPS Cartograph allowing connection to GPS systems (see separate entry in this section).

Specifications

Sensor: Föerster-Fluxgate Gradiometer
Sensor spacing: 650 mm
Search sensitivity: 8 linear steps from 3 nT to 10,000 nT, or full logarithmic range (resolution 0.3 nT)
Power supply: 4 x 1.5 V D-size monocells, IEC LR 20
Temperature range (storage): –57 to +70°C
Temperature range (operating): –35 to +70°C

FEREX 4.032 with API control unit in use (Föerster) 0568669

Weight: approx 4 kg
Weight (in transit case): approx 9 kg
Dimensions: approx 700 x 1,600 mm

FEREX control units: API, DLG (Föerster) 0568668

Status
In production and believed to have been in service in Afghanistan, Australia, Austria, Bulgaria, Canada, Croatia, Denmark, Egypt, Finland, France, Germany, Indonesia, Iran, Ireland, Italy, Japan, the Netherlands, Poland, Portugal, the Russian Federation, Spain, Tunisia, Uruguay, the UK, the US and Vietnam.

Contractor
Institut Dr Föerster GmbH and Co KG.

FEREX 4.032 borehole version (Föerster) 0074210

FEREX DATALINE software

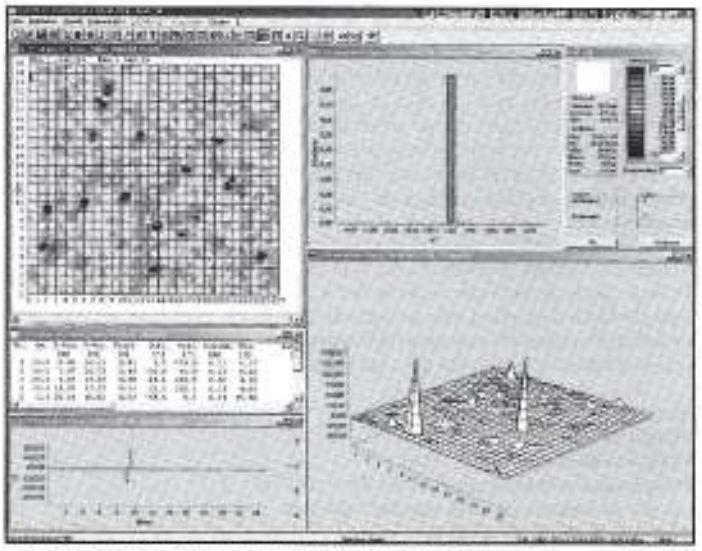
Description
FEREX DATALINE is a Windows-based interactive evaluation software compatible with Windows 95, Windows 98, Windows NT, Windows 2000 and Windows XP. Showing the position of scanned objects, DATALINE allows accurate evaluation, creating colour-coded magnetic anomaly maps, object lists and true-to-scale object maps.

Once the information from FEREX DLG metal detectors has been loaded into a personal computer workstation or laptop, the software can be employed to present a colour-coded anomaly map for evaluation. FEREX DATALINE can also load a map into the field to be edited or processed. The map can be scaled and turned so that it is embedded in the correct location. The results of the evaluation can be presented in parallel as an object list, a three-dimensional view, a histogram, or as a track evaluation, all in addition to the colour-coded map. Using GPS, various co-ordinate systems are available to create maps to suit specific customer requirements.

Fields can be enlarged to enable further data to be incorporated; field data can also be filtered in order to optimise the evaluation process.

Status
In production. In use in several countries.

Contractor
Institut Dr Föerster GmbH and Co KG.



A typical FEREX DATALINE presentation display (Föerster) 0568663

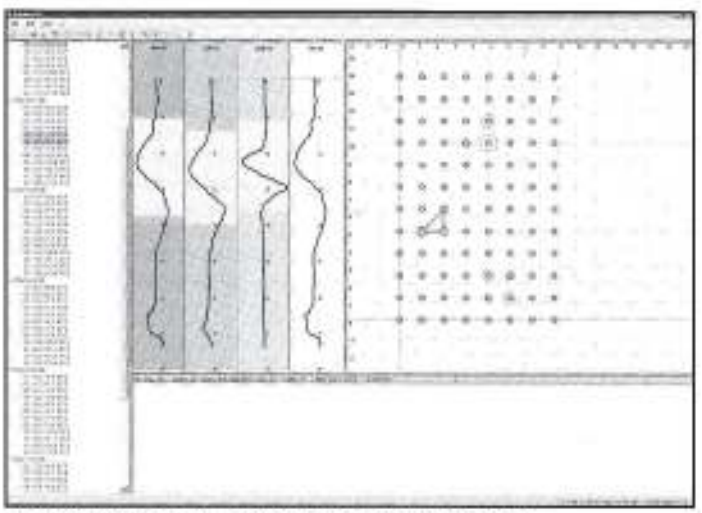
FEREX DATALINE BM

Description
FEREX DATALINE BM is an evaluation software program for magnetic field distributions (geomagnetic data) recorded in boreholes. It is used to locate ferromagnetic objects.

FEREX DATALINE BM offers various options for processing borehole data recorded by a FEREX Datalogger STD (see separate entry). The data can then be analysed, evaluated, displayed graphically, imported, loaded, saved and documented.

The software can calculate the position (x/y) and size (diameter and volume) of suspected ferromagnetic objects. It can object depth with an indication of a quality number and provide inclination and declination of the objects, relative to the magnetic centre of gravity. FEREX DATALINE BM has the ability to correct borehole positions and/or add bolehole data when not all data has been recorded with the Datalogger. The software gives a graphic representation of the boreholes and objects in the borehole field map. A user can print out object lists in a text file and the borehole map if required.

Specifications
System requirements
Processor: min Pentium 4
≥512 MB RAM
VGA graphics card or better, ≥256 colours wherever possible
1 free serial port RS-232
1 usable USB port for the dongle



FEREX DATALINE BM – borehole data evaluation screen (Foerster) 1168244

Status
In production.

Contractor
Institut Dr Foerster GmbH and Co KG.

FEREX MAGNETO Data Acquisition System

FEREX MAGNETO data acquisition system in use (Föerster) 0511647

Description

The Föerster FEREX MAGNETO is no longer in production, having been succeeded by the FEREX 4.032 DLG datalogger (see separate entry). The FEREX Magneto is a data collection and evaluation system for magnetometer scanning using the FEREX 4.021 search instrument. The system consists of a portable data logger with high resolution and storage capacity for track scanning of areas up to four hectares in one measurement. After the transfer of collected data to a personal computer via a standard interface, interactive Windows software is used for a true-to-scale presentation of the data either by colour-coded magnetic maps, by ISO lines, by a three-dimensional display, or by a display of individual tracks. The final results are presented in an object list and true-to-scale object maps.

Status

No longer in production. Replaced by the FEREX 4.032 DLG.

Contractor

Institut Dr Föerster GmbH and Co KG.

METEX 4.125 mine detector

METEX 4.125 in use (Föerster) 0511648

Description

The Föerster METEX 4.125 is a one-frequency continuous wave mine detector which replaced the earlier METEX 4.122. It can be used to detect any ferrous or non-ferrous metal objects, but its primary role is in the detection of mines underground and in shallow water. Metallic Anti-Tank (AT) mines can be detected to a depth of approximately 700 mm; minimum-metal mines can also be detected.

The METEX 4.125 is constructed to military standards of design and operation and uses light, splash-proof components; the search coil may be used completely under water. Standard 1.5 V batteries are used for the power supply and the instrument has built-in functional and battery test features.

The METEX 4.125 has three basic components: a search coil with telescopic handle; a control unit with power supply; and headphones. The complete system can be supplied in an aluminium transit case which also contains a carrying bag with strap, test piece, handgrip, armrest and rucksack. The detector can also be fitted with a telescopic truncheon probe approximately 400 to 1,100 mm in length.

Specifications

Weight of components: 3.5 kg
Weight with transit case: 15 kg
Dimensions of transit case: 0.74 × 0.4 × 0.16 m
Length of search coil with handle: 0.94–2 m
Search coil diameter: 0.26 m
Truncheon probe diameter: approx 30 mm
Truncheon probe length: 400–1,100 mm
Batteries: 6 × 1.5 V (IEC R14)
Battery life: 80 h approx

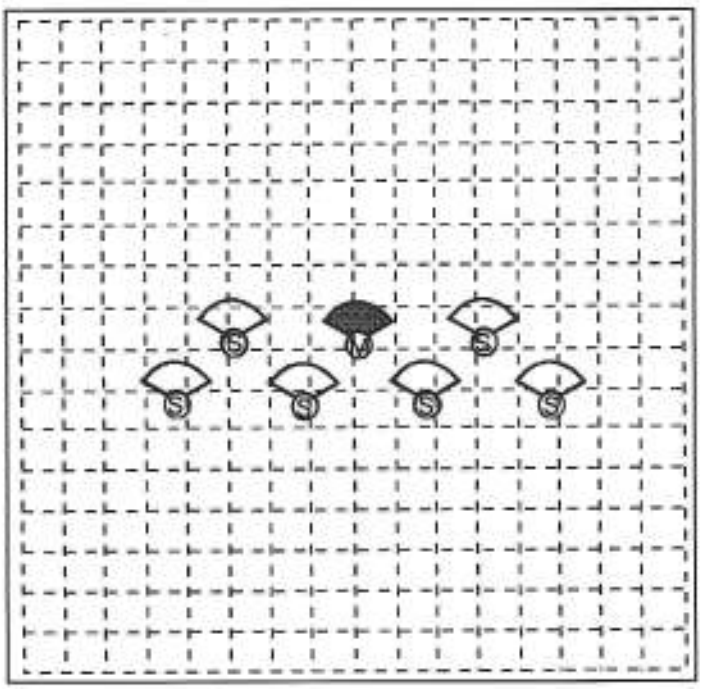
Status

No longer in production. In service with several (undisclosed) countries.

Contractor

Institut Dr Föerster GmbH and Co KG.

MINEX 2000 P metal detector



MINEX 2000 P search in a group, with master unit in the centre and slave units symmetrically around
0021495

Description

Now no longer in production, the Föerster MINEX 2000 P metal detector was the first pulse induction metal detector produced by the company. It was designed as an economical instrument intended to fulfil a wide range of search tasks in all climates and environments, including fresh and saltwater.

The MINEX 2000 P has a lightweight probe and a carbon fibre telescopic handle with an embedded probe cable. It employs advanced pulse detection techniques during both static and dynamic search operations, and produces no interference between two or more detectors operating in close proximity. The instrument is easy to adjust and there is automatic monitoring of battery condition (including an indication of the need for battery replacement).

Status

No longer in production.

Contractor

Institut Dr Föerster GmbH and Co KG.

MINEX 2000 SL mine detector

Description

Now no longer in production, the Mine Detector MINEX 2000 SL was developed from the MINEX 2FD (see separate entry). It achieved a significant weight reduction over the MINEX 2FD because of a redesign of the probe and the introduction of a carbon fibre telescopic handle. The instrument uses a microprocessor-controlled two-frequency search system which provides good search sensitivity, selectivity and pinpointing. The manufacturer claims that the search system is not affected by magnetic soils, fresh or salt water, and can be used in any climate or environment. The MINEX 2000 SL can be employed in computer-controlled multi-probe and vehicle-mounted systems.

Specifications

Power supply: 3 × 1.5 V D cells
Operating duration: 30 h (at 20°C)
Operating temperature: –32 to +55°C
Weight (probe with handle): 1.5 kg
Probe diameter: 260 mm
Handle length: 1.3–1.9 m

Status

No longer in production.

Contractor

Institut Dr Föerster GmbH and Co KG.

MINEX 2FD 4.400 Mine Detector

Description

The Föerster MINEX 2FD 4.400 mine detector was created as an improved version of the METEX 4.125 (see separate entry). It is claimed to be the first metal detector to have incorporated two frequencies operating simultaneously. It is also claimed that the 2FD 4.400 is the first instrument of its kind to use a multilayer printed circuit board 'coil system'.

Together with its microprocessor-controlled phase selection, the 2FD 4.400 can achieve maximum sensitivity to all metals and optimal ground suppression at the same time. The instrument is microprocessor-controlled during operation for ground exclusion balance, sensitivity adjustment and for displayed detection and fault signals. The detector also incorporates functional and battery test features.

The detector is constructed to military standards and uses strong, waterproof subassemblies; it may be used under all climatic conditions and under both fresh and salt water.

Power is provided by three 1.5V IEC R20 alkaline batteries. The complete equipment can be supplied in an aluminium transit case which also contains a carrying harness, a test piece, a handgrip and armrest, and a rucksack.

The MINEX 2FD 4.400 has been in field use since 1991 but its successor, the MINEX 2FD 4.500 (see separate entry), is also now in service in many countries.

Specifications

Search head diameter: approx 257 mm
Probe length: approx 0.8–1.85 m
Operating time at ambient 20°C: 30 h
Operating temperature: –32 to +60°C
Storage temperature: –55 to +75°C
Claimed detection capabilities
Type 72 (AP): 80 mm
M14: 110 mm
VS-50: 280 mm

Status

No longer in production.

Contractor

Institut Dr Föerster GmbH and Co KG.

MINEX 2FD 4.400 in use 0511649

MINEX 2FD 4.500 mine detector

Description

The MINEX 2FD 4.500 is a compact, lightweight, one-piece metal detector which can be deployed immediately on removal from the transportation case. The manufacturers claim extremely high detection sensitivity and 'pinpointing ability' for all metals, and particularly for minimum-metal mines. Features include a 'Ground Learn Function' which masks interference signals from magnetic soils or salt water. The detector uses twin frequencies to provide clear tone signal sequence and it is not affected by external factors such as interference caused by power lines. It is designed to be easy to operate.

The MINEX 2FD 4.500 has an entirely new oval detection coil which can be rotated through 180° and an anti-twist telescoping handle with toggle locking. Ease of use is aided by the 'one-finger touch' operating panel and adjustable armrest.

The MINEX 2FD 4.500 meets the military standard MIL-STD 810.

Close up of the control box
(Föerster)
0074207

Specifications
Search head (oval): 210 × 285 mm
Probe length: 0.92–1.67 m

Weight
detector: 2.15 kg
transportation and storage case: 4.0 kg
backpack: 0.8 kg
set of batteries: 0.4 kg
Power supply: 3 × 1.5 V mono-cell IECLR 20 (ANSI STD size D)
Operating time with IECLR 20 batteries: approx 45 h at ambient temperature of 20 °C
Operating temperature (with Alkali-Mangan batteries): –37 to +71°C
Storage temperature (without batteries): –57 to +71°C

Status
No longer in production.

Contractor
Institut Dr Föerster GmbH and Co KG.

MINEX 2FD 4.500 compact detector in use (Föerster)
0543379

MINEX 2FD 4.530 mine detector

Description
The Minex 2FD 4.530 is a lightweight, compact metal detector developed as an improvement of the Minex 2FD 4.500 (see separate entry). It is claimed by Föerster to provide maximum sensitivity and superior pinpointing for all metals. This includes the small metal parts found in previously undetectable plastic mines. There are five sensitivity ranges, allowing the user to adapt to different detection tasks.

Similar to the 4.500, the detector has a two-tone detection system for the precise pinpointing of metals. The audio signal on the latest detector is claimed to be noticeably enhanced. The 'Ground Learn Function' featured on the 4.500 to mask interference signals from magnetic soils or salt water, has been simplified and enhanced to provide an improved ground learning capability. Another improved feature is the addition of a digital interface, allowing software updates and fault diagnosis.

The detector features lockable telescopic adjustment, allowing for use at different heights and lengths.

The Minex 2FD 4.530 meets the military standard MIL-STD 810E.

Specifications
Search head (oval): 210 × 285 mm
Probe length: 930 – 1,660 mm

Weight
detector (without batteries): 2.2 kg
transportation and storage case: 5.7 kg
backpack: 0.7 kg
set of batteries: 0.4 kg
Power supply: 3 × 1.5 V mono-cell IECLR 20 (ANSI STD size D) or 3 × 1.2V NiMH batteries 9,000 mAh
Operating time:
IECLR 20 batteries: approx 40 h at ambient temperature of 20°C
NiMH batteries 9,000 mAh: approx 30 h at ambient temperature of 20°C
Operating temperature:
Alkali-Mangan batteries: –37°C to +60°C
NiMH batteries: –20°C to +60°C
Storage temperature (without batteries): –57°C to +71°C

Status
In production.

Contractor
Institut Dr Foerster GmbH and Co KG.

MINEX 2FD 4.530 (Foerster) 1293502

MD-3 hand-held metal detector

Description
The MD-3 is a compact, hand-held metal detector with a round search head that folds up for ease of storage. It is designed to detect both ferrous and non-ferrous metals, and the manufacturer claims it can detect a 7.62 mm cartridge at a depth of 200 mm.

Location of a target is signalled by means of an audible alarm. The sensitivity of the detector can be adjusted using a screwdriver to turn a recessed screw. The detector can be powered by batteries or by a DC supply.

A PVC carrying bag is also provided.

Specifications
Detection depth (7.62 mm cartridge): 200 mm
Current consumption: <16 mA
Search head diameter: 134 mm

Length
operational: 329 mm
storage: 258 mm
Power supply: 9 V DC Ni/Cd rechargeable battery IEC 6F22 or dry battery IEC 6F22

Weight
operational (with battery): 270 g
carrying case: 80 g
Operating temperature: –10 to +50°C

Status
No longer in production but still available.

Contractor
Force Ware GmbH.

MD 6 Hand Held Metal Detector

Description
The MD 6 is the latest hand-held metal detector which alerts the operator in three different alarm modes (silent vibration, LED light bar, and piezo sounder) when any type of concealed conductive metal is detected, from pins and razor blades to knives and handguns, including ferrous, non-ferrous, and stainless steel items.

In normal use, the MD 6's low power consumption allows 2,000 searches on one 9 V battery. The MD 6 is a lightweight unit which is held in a high-impact plastic case with rubber handle. A ballistic Nylon carry holster is available for carrying the MD 6 on a duty belt or mounting in a car. The MD 6 is safe for operators and subjects involving pregnancies or pacemakers.

Specifications
Length: 315 mm
Width: 50 mm
Weight: 280 g
Operating current: 80 mA typical

MD 6 Hand Held Metal Detector (Force Ware GmbH) 1334745

Operating frequency: 95 kHz
Operating voltage: 6.8–10 V DC
Battery: 9 V standard or alkaline, lasts 2000 typical scanning operation

Status
In production.

Contractor
Force Ware GmbH.

Vallon EL 1302D2 ferrous locator

Description
The Vallon EL 1302D2 ferrous locator, developed from the EL 1302A1, is a highly sensitive difference magnetometer used for the detection of bombs, shells, mortar projectiles and other unexploded ordnance. It indicates any disturbance caused in the earth's magnetic field by buried ferrous objects, providing indications to the operator both acoustically and visually. This equipment is used for land-based detection and the locators have an interface for the Vallon field computer VFC1 (see separate entry).

The EL 1302D2 is designed for all-weather use, using glass fibre and carbon fibre materials to reduce the weight of the locator.

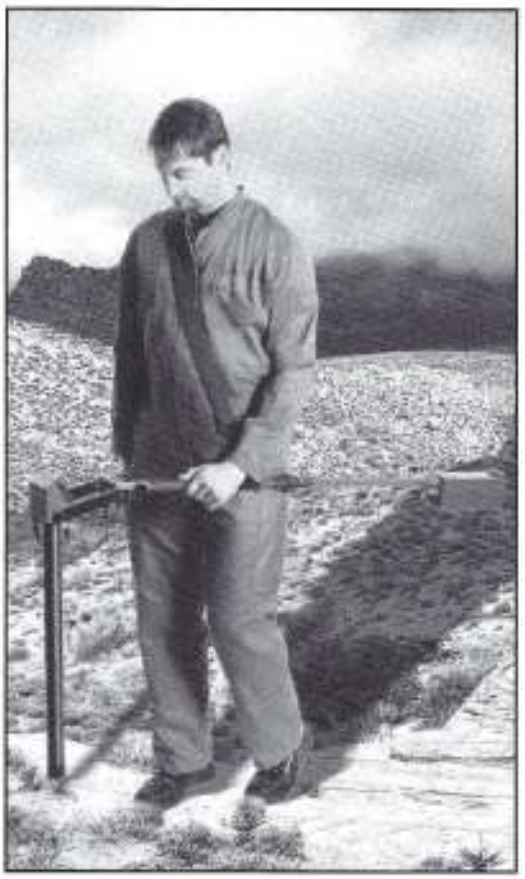
The EL 1302D2 is equipped with a digital signal output for direct connection to the Vallon Memo Box MB4, the Vallon field computer VFC1 and for direct data recording in conjunction with a commercial laptop computer running Vallon EVA2000® software. To relate the exact x-y co-ordinates to the measured data, the Vallon sensor positioning system (SEPOS®) or a GPS receiver with antenna and a GPS reference station receiver can be connected.

Operation is claimed to be simple, with only a short training period required.

The VFC1 field computer (carried on the locator) displays in real time the measured nano-Tesla (nT) values as a curve. In addition, the GPS position is displayed (corrected once every second), along with an integrated GPS window that guides the operator using simple symbols for walking direction and starting and stopping positions. The operator is thus guided by the VFC1.

After a survey, the recorded data from the VFC1 are downloaded to a laptop or PC running the EVA2000® software. The operator can then evaluate any suspected UXO targets. A complete target list and true-to-scale map can be printed out for follow-up operations. Both the lists and maps indicate the field and each target, by its GPS position in latitude and longitude.

Specifications
Weight (with batteries): 4.0 kg
Shipping weight: 11.6 kg
Dimensions of case: 785 × 285 × 140 mm
Power supply: 6 × 1.5 V batteries, type IEC R14
Detection depth: up to 6 m
Operating temperature: –40°C to +60°C
Measuring range: ×1 = ± 2–2000 nT, ×10 = ± 20–20000 nT


Vallon ferrous locator EL 1302D2 (Vallon) 1333756

Status
In production. In service in countries worldwide.

Contractor
Vallon GmbH.

For details of the latest updates to *Jane's Explosive Ordnance Disposal* online and to discover the additional information available exclusively to online subscribers please visit **jeod.janes.com**

Vallon EL 1303D2 multipurpose ferrous locator

Description

The Vallon multipurpose ferrrous locator EL 1303D2, based on the EL 1303A1, is a highly sensitive difference magnetometer used for the detection of bombs, shells and other unexploded ordnance in the ground, in boreholes and in water.

The EL 1303D can be connected to the Vallon Field Computer VFC1 (see separate entry) for data recording and the data output is via cable or Blue Tooth.

The locator is equipped with a digital signal output for direct connection to the Vallon Memo Box MB4, the Vallon Field Computer VFC1 and for direct data recording in conjunction with a commercial laptop or PC running the Vallon EVA2000® software. To relate the exact x-y co-ordinates to the measured data, the Vallon sensor positioning system (SEPOS®) or a GPS receiver with antenna and a GPS reference station receiver can be connected.

The detector consists of an electronic box with battery compartment, carrying bar, display and operation unit, sensor tube and cable drum. Different detector components can be combined according to the detection task. The standard sensor cable has a length of 25 m; the maximum length is 100 m. TheEL1303D2 comes with a splash-watertight universal case housing the complete set with cable drum.

Specifications

Weight (with batteries): 4.0 kg
Shipping weight: 12.6 kg
Case dimensions: 785 × 285 × 140 mm
Detection depth: up to 6 m
Cable drum: 25 m sensor cable
Weight of cable drum: 5.8 kg
Power supply: 6 × 1.5 V batteries, type IEC R14
Battery life: approx 50 h with alkaline batteries
Operating temperature: –40°C to +60°C
Measuring range: ×1 – ± 2-2000nT, ×10 – ±20-20000 nT

Status

In production. In service with many countries worldwide.

Contractor

Vallon GmbH.

Ferrous locator EL 1303D components (Vallon) 0074465

Vallon multipurpose ferrous locator EL 1303D2 (Vallon) 1333757

Vallon EVA2000® 2.14 software

Description

Vallon EVA2000® 2.14 evaluation and analysis software is used in combination with ferrous locators and metal detectors for project management during EOD operations. It is designed to process large-scale survey data recorded on land, in boreholes and underwater. The software can be used with all Vallon ferrous locators (magnetometers) and metal detectors with digital outputs and all Vallon data loggers.

The software runs on Microsoft Windows operating systems (starting from Windows 95). Possible features include:

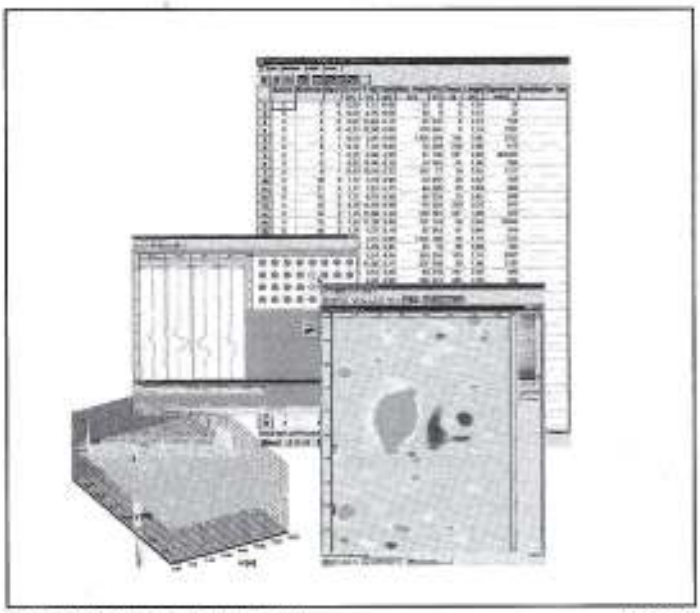
- real-time data acquisition direct to a laptop or personal computer from up to eight sensors simultaneously
- the ability to run with SEPOS® or GPS
- GPS navigation
- GPS target search
- automatic target calculation
- production of target lists with co-ordinates, depth, orientation and filtering functions
- true-to-scale target and background maps
- import and export of ASCII-formatted files.

SEPOS® is a trademark of Vallon GmbH for the patented positioning system for land survey and borehole detection with ferrous locators.

Vallon EVA2000® software has export functions and vectorial georeferencing exportation of the colour map to a GIS for example Google Earth™ or AutoCAD®.

Status

In production. In service in Belgium, France, Germany, Netherlands, US and with many civil EOD companies.



EVA2000® output data (Vallon) 0532028

Contractor

Vallon GmbH.

Vallon MB4 Memo Box data logger

Description
The MB4 is a compact, watertight and non-magnetic data logger for recording unexploded ordnance detection survey data. Operation is claimed to be simple, with the operational elements limited to a programme selector and a start/stop key. Two seven-segment LED-displays indicate the programme status to the operator.

The Memobox has a maximum storage capacity of 27 km track length at a speed of 1 m/s. Collected data can be transferred to a personal or laptop computer for analysis and evaluation using Vallon EVA2000® software (see separate entry).

Specifications
Weight: 500 g
Housing dimensions: 100 × 42 × 140 mm
Input: digital
Total memory: 4 MB
Number of tracks: 100 (0 to 99)
Number of fields: 100 (0 to 99)
Power supply: external battery from locator/detector

Memo box MB4 records UXO detection survey data (Vallon) 0573281

Status
Available.

Contractor
Vallon GmbH.

Vallon MC1 Micro Computer

Description
The Vallon MC1 is designed for use by EOD personnel. It comprises a microcomputer and self-contained software to support detection work. The real-time changes in magnetic field are graphically indicated on a display which also shows the previous 5 m of measured track. Object depth and position can be calculated on site.

Operation is possible after a short training period as the MC1 integral software prompts the operator using a simple menu technique. Software modules for land and borehole detection are included. The Sensor Position System (SEPOS®) or a DGPS unit can be connected to relate the exact x-y co-ordinates to the measured data. Recorded data can be transferred to a personal computer or laptop and evaluated using the EVA2000® software package (see separate entry).

Power is supplied to the MC1 from the ferrous locator.

Specifications
Display size: 100 × 80 mm
Temperature range: –10 to +50°C
Dimensions: 140 × 180 × 80 mm
Weight: 1.4 kg
Number of tracks: 80 × 220 m or 160 × 110 m
Inputs: sensor (analogue), SEPOS®/DGPS
Outputs: RS-232 (COM) to PC, printer (LPT)
Power supply: from ferrous locator

Status
No longer in production. In service in Belgium, France, Germany, Netherlands and many other countries.

Contractor
Vallon GmbH.

Vallon MC1 Micro Computer (Vallon) 0074463

Vallon MC1 Micro Computer with ferrous locator and SEPOS® (Vallon) 0532026

Vallon ML 1620C mine detector

Description
Based on the widely used ML 1620B, the ML 1620C has improved capability to detect minimum metal mines in strongly mineralised soil and under power lines. The detection sensitivity in normal soil has also been improved in order to give the operator a reliable, simple and compact instrument that can be used in all soil conditions (including sand, laterite and magnetite). The detector is waterproof to a depth of 2 m. The operating length of the telescopic carrying bar can be continuously adjusted from 96 to 190 cm.

The computer-optimised design of the search head allows the precise location of small metallic objects without loss of detection speed when

compared to a large ring-shaped coil. An optional stick probe with a solid tip can be used in undergrowth, hay and other loose material.

The electronics unit has an automatic battery test facility, a volume control and continuously adjustable sensitivity. The detector adapts itself automatically to the ambient ground conditions so that constant recalibration procedures are not necessary.

Specifications
Weight of instrument: 3.2 kg
Shipping weight complete: approx 12 kg
Working length, long: 1.9 m
Working length, short: 0.96 m
Dimensions of case: 782 × 300 × 142 mm

Status
No longer in production. In service with various humanitarian aid organisations, United Nations and private mine clearance companies.

Contractor
Vallon GmbH.

Vallon mine detector ML 1620C ready for use (Vallon GmbH) 0074018

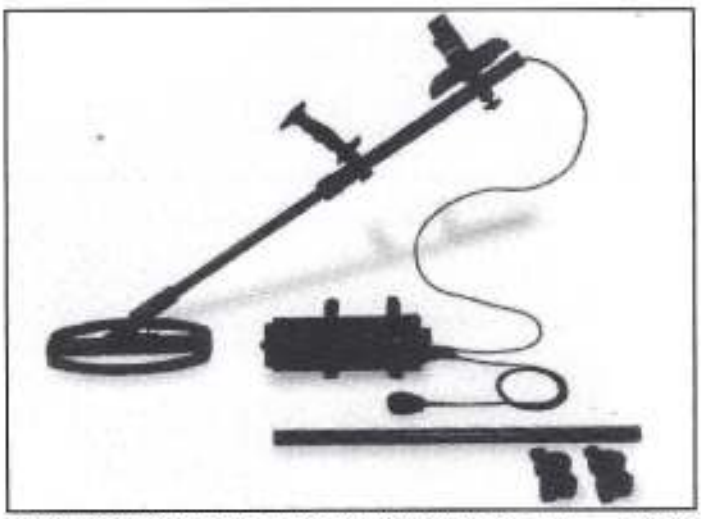
Vallon MW 1630B underwater metal detector

Development
The Vallon underwater metal detector MW 1630B design is optimised for divers for underwater operations down to 60 m depth; for operation in rivers with strong currents and in the sea.

Description
The electronics unit is carried on the diver's leg, leaving only the search head, with its lightweight telescopic pole, to be carried by hand. The electronics are housed in a cylindrical, rigid, non-metallic case with sensitivity adjustment carried out by a single mechanical rotary switch. Volume control is operated by a two-step toggle switch.

The detector can operate in fresh and salt water and also in highly mineralised soils without losing sensitivity. The search head is oval, giving a narrow swept path (170 mm wide) suitable for operations in areas with dense clutter, rocks or plants. Power is provided by commercial batteries monitored by an automatic battery voltage check. The detectors also feature permanent monitoring of the voltages and circuits without affecting the acoustic search signal. The unit provides constant sensitivity almost down to battery discharge level. An acoustic alarm sounds when the lowest voltage point is reached.

A new model with automatic ground compensation, the VMW1 was fielded in 2006 and is in production.



Vallon underwater mine detector MW 1630B (Vallon GmbH) 1041289

MW 1630B in operation (Vallon GmbH) 0511646

Specifications
MW1630B
Weight
underwater: 1 kg
on land: 3.9 kg
electronics unit with batteries: 2.4 kg
shipping weight: 11.6 kg
Working length
minimum: 540 mm
maximum: 1,450 mm
Dimensions:
(search head): 170 × 305 (oval)
(transport case): 782 × 300 × 142 mm
Power supply: 3 × 1.5 V D size batteries or rechargeable cells
Operating temperature:
(underwater) 0° to +35°
(land) –31° to +55°
Storage temperature: –55° to +75°

Status
In production. MW 1630 in service with the United States Navy since 1992 (Mark 29). MW 1630B in service with Belgium, France, Germany, Netherlands and other (undisclosed) countries.

Contractor
Vallon GmbH.

Vallon VET1 ferrous locator

Description

The Vallon VET1 is a highly sensitive difference magnetometer designed for the detection of bombs, shells and other unexploded ordnance buried in the ground at depths of up to 10 m.

The large distance between the sensors of the VET1 (1.7 m) enables the detection of field strength differences produced by very deeply buried objects, and is mainly used for the examination of the subsoil. The manufacturer recommends an initial area survey using a standard ferrous locator in order to clear all ferromagnetic objects to a depth of 3 m.

The locator monitors the earth's magnetic field and signals visually and acoustically any disturbance of the field caused by a buried ferrous object. During conventional detection the measured data are read off the indication meter.

By connecting the Vallon Field Computer VFC1 (see separate entry) the measured data can be stored, displayed as graphs and subsequently evaluated. To relate the exact x-y co-ordinates to the measured data, the Vallon sensor positioning system (SEPOS®) or a GPS receiver with antenna and a GPS reference station receiver can be connected.

On completion of the survey, the recorded data from the VFC1 are downloaded to a laptop or PC running the Vallon EVA2000® software (see separate entry). The operator can then evaluate any suspected UXO targets. A complete target list and true-to-scale map can be printed out for follow-up operations. The lists and maps indicate the field and each target by its GPS position in latitude and longitude.

Vallon has now developed the VET2 ferrous locator (see separate entry).

Specifications

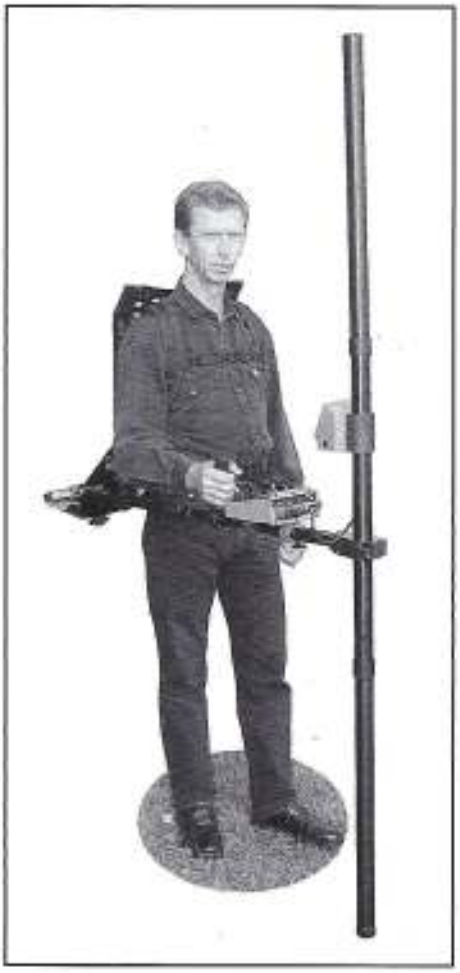
Weight
total unit with accumulators: 8.0 kg
sensor tube: 3.3 kg
electronics unit: 1.1 kg
Power supply: 1 set of accumulators (12 V 9.2 Ah)
Detection depth: up to 10 m

Status

In service in many countries worldwide.

Contractor

Vallon GmbH.



Vallon VET1 ferrous locator with the VFC1 field computer
(Vallon)
0074809

Vallon VEV3 multisensor vehicle

Description

The Vallon VEV3 multisensor vehicle is a replacement for the earlier MSV 5. It was developed for the detection of UXO over large areas. The vehicle incorporates an array of ferrous locators operating with a Vallon Field Computer VFC1 (see separate entry). To relate the exact x-y co-ordinates to the measured data, the Vallon Sensor Position System (SEPOS®) or a GPS receiver with antennas and a GPS reference station can be connected.

The VEV3 carries standard Vallon ferrous locators for land use; other special vehicles are required to carry the locators on or under water. The locators can be removed from the array and used individually for hand-carried operations.

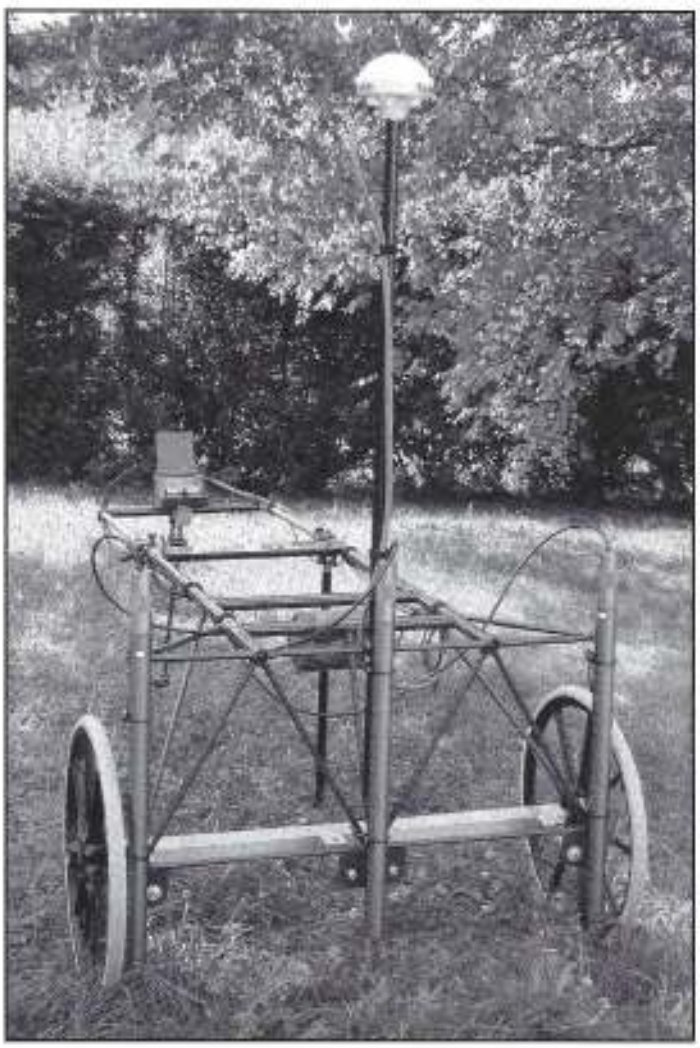
After the survey operation is complete the data is transferred to a personal computer and evaluated using the Vallon EVA2000® software package (see separate entry).

Status

Replaced by the VXV4 multisensor vehicle (see separate entry). In service with commercial EOD operators.

Contractor

Vallon GmbH.



Vallon VEV3 multisensor vehicle
(Vallon)
0074808

Vallon VFC1 field computer

Development
The Vallon Field Computer VFC1 data logger for explosive ordnance disposal (EOD) is used for the computer-aided detection of UXO in combination with ferrous locators.

Description
The VFC1 can be connected to up to four ferrous locators or metal detectors along with GPS for navigation. The electronics processes both analog and digital signals of the connected sensors. The powerful electronics, which is protected by a weather-resistant metal housing of 1,000 cm³ only, allows to record and to store the measured signals of 4 analog sensors and data of an area of 8 ha. During use, changes in magnetic field are graphically indicated as curves on the display in real time. Object depth and position can be calculated on site, and the data can be transferred to a memory stick or personal computer (in less than 1 minute) for evaluation and analysis with the Vallon EVA2000® software (see separate entry).

The installed software can be used for land survey, for borehole detection or to locate objects already positioned by GPS.

Specifications
Weight: 1.4 kg
Dimensions: 140 × 200 × 70/80 mm
Display size: 100 × 80 mm
Input: analogue/digital
Max field size: 1 track with 120 km length or 1200 tracks with 50 m length
Total storage capacity: 4 × max field size
Power supply: external battery (6 to 17 V)

Status
In production.

Vallon VFC1 field computer (Vallon) 0632027

Contractor
Vallon GmbH.

Vallon VMC1 retractable metal detector

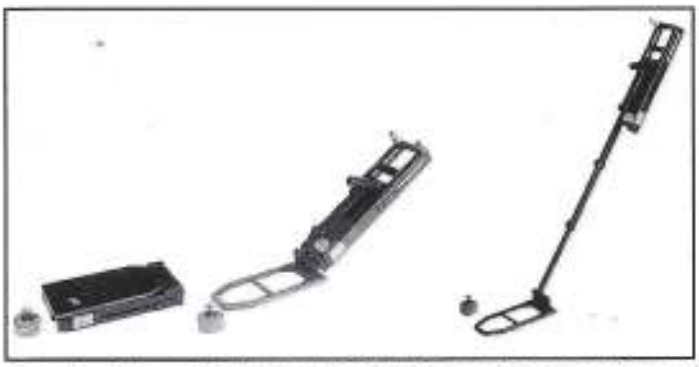
Development
The Vallon VMC1 has been designed for the highly accurate detection of all types of ferrous and non-ferrous metals, such as metallic mines, plastic mines with minimal metal content, shells, UXO, ammunition and other metal objects in the ground or in shallow water.

Description
The VMC1 uses modern Digital Magnetic Pulse Induction (DMPI) technology and is designed to provide enhanced detection sensitivity and detection stability in all soil and water conditions.

The detector has a new, one-piece retractable design and is supplied in a soft carrying bag with a carrying belt housing the complete set and a non-magnetic prodder. Its small packed size facilitates easy transportation and storage in personal luggage or in vehicles.

The modern electronics are designed to withstand all typical environmental and vibration requirements and meets MIL STD 810E. Detected metal objects are clearly indicated by audio signal, 12-element LED bar graph and vibrator in the electronics housing. The operator can select individual alarm indications; clear alarms enable the operator to work without a headset.

Automatic continuous self-check and automatic detection level control maintain sensitivity over hours of continuous operations and independently of battery level, temperature and other environmental conditions.



The retractable metal detector VMC1 folds for ease of transportation and storage (Vallon) 0573665

An ergonomic design with the visual display integrated into the handgrip allows for easy operation and minimal operator training.

The length of the telescopic carrying bar is adjustable from 600 to 1,240 mm. An oval search head facilitates operation in difficult and dense vegetation, rocks, shallow water and mud. It is also claimed to provide precise pinpointing and excellent separation between narrowly placed metal objects.

Operator controls are limited to a one-mode selector with two soil programmes and three push buttons for setting the sensitivity level, audio signal volume and compensation/ground balance. Data input allows for further upgrade of the detector software.

Specifications
Collapsed size: 360 × 140 × 70 mm
Weight, hand-held unit (with batteries): 2.5 kg
Shipping weight: 2.8 kg

Working length
min: 600 mm
max: 1,240 mm
Power supply: 3 × 1.5 V C size batteries

Status
In production. In service in many countries worldwide.

Contractor
Vallon GmbH.

VMC1 operating controls (Vallon) 0573666

Vallon VMH3 metal detector

Development

The Vallon VMH3 has been designed for the detection of all types of ferrous and non-ferrous metals such as metallic mines, plastic mines with minimal metal content, shells, UXO and other metal objects in the ground or in shallow water. This one-piece design is intended to meet the specific needs of mine clearance professionals in post-conflict areas.

Description

Modern Digital Magnetic Pulse Induction (DMPI) technology provides improved detection sensitivity and detection stability in all soil and water conditions. The soil programmes available make it effective in areas with severe mineralised conditions or individual mineralised stones. An ergonomic design and light weight enable it to be used comfortably over extended periods.

The electronics are designed to withstand all typical environmental and vibration requirements and meets MIL STD 810E. Detected metal objects are clearly indicated by audio signal, 14-element LED bar graph and vibrator in the electronics housing. The operator can select individual alarm indications; clear alarms enable the operator to work without a headset.

Automatic continuous self-check and automatic detection level control maintain sensitivity over hours of continuous operations and independently of battery level, temperature and other environmental conditions.

Operator controls are limited to a one-mode selector with two soil programmes and three push buttons for sensitivity level, audio signal volume and compensation/ground balance. The detector can be used with minimal operator training.

The telescopic carrying bar is adjustable from 793 to 1,386 mm. An oval search head facilitates operation in difficult and dense vegetation, rocks, shallow water and mud. It is also claimed to provide precise pinpointing and excellent separation between narrowly placed metal objects. Update of operation software and adaptation to individual requirements are possible.

The VMH3 is supplied with a semi-hard carrying case, which can be used as a backpack.

Specifications

Weight, hand-held unit oval search head (with batteries): 2.6 kg
Dimensions: search head (oval) 31 × 17 cm ±5 mm
Shipping weight: 4.9 kg
Length
min: 793 mm
max: 1,386 mm
Power supply: 3 × 1.5 V D size batteries or rechargeable
Battery life: up to 25 hours depending on battery type and SOIL program
Operating temperature: –31°C to +63°C
Storage temperature: –51°C to +71°C

Status

In production. In service in many countries worldwide.

Contractor

Vallon GmbH.

VMH3 operating elements (Vallon) 1041297

Folded VMH3 (Vallon) 1041298

Vallon metal detector VMH3 (Vallon) 0573661

Vallon VMH3CS metal detector

Description

The Vallon VMH3CS has been designed for the highly accurate detection of all types of ferrous and non-ferrous metals, such as metallic mines, plastic mines with minimal metal content, shells, UXO, ammunition and other metal objects in the ground or in shallow water. A 600 mm search head can additionally be used to locate buried metal-cased mines and non-exploded ordnance at greater depth. This compact, one-piece design is intended to meet the specific needs of mine clearance professionals in post-conflict areas. An ergonomic design and light weight enable it to be used comfortably over extended periods.

Modern Digital Magnetic Pulse Induction (DMPI) technology is designed to provide enhanced detection sensitivity and detection stability in all soil

and water conditions. The soil programmes available make it effective in areas with severe mineralised conditions or single mineralised stones.

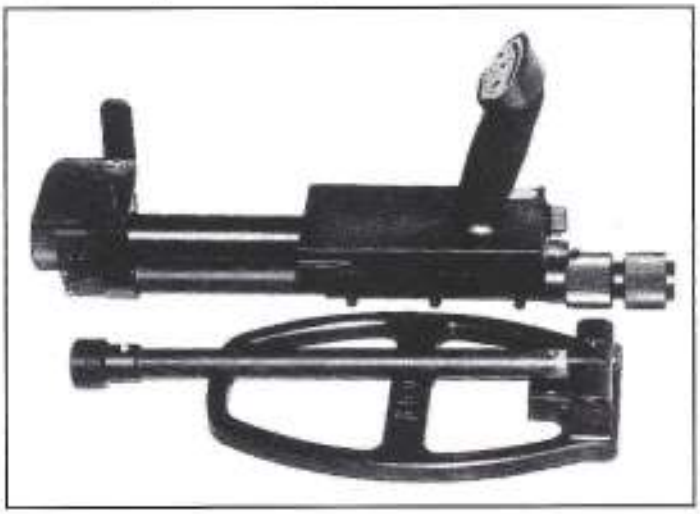
The modern electronics are designed to withstand all typical environmental and vibration requirements and meets MIL STD 810E. Detected metal objects are clearly indicated by audio signal, 12-element LED bar graph and vibrator in the electronics housing. The operator can select individual alarm indications; clear alarms enable the operator to work without a headset.

Automatic continuous self-check and automatic detection level control maintain sensitivity over hours of continuous operations and independently of battery level, temperature and other environmental conditions.

Operator controls are limited to a one-mode selector with two soil programmes and three push buttons for sensitivity level, audio signal volume and compensation/ground balance. The detector can be used with minimal operator training.

The length of the carrying bar is adjustable from 912 to 1,253 mm. The oval detector head facilitates operation in difficult and dense vegetation, rocks, shallow water and mud. It is also claimed to provide precise pinpointing and excellent separation between narrowly placed metal objects. Update of operation software and adaptation to individual requirements are possible.

The VMH3CS is supplied with a backpack. A hard carrying case is available as an optional accessory.



VMH3CS components (Vallon) 1041293

VMH3CS hard case and backpack (Vallon) 1041292

VMH3CS metal detector in use in Afghanistan (Vallon) 1299243

Vallon VMH3CS metal detector (Vallon) 1041294

Specifications
Weight, hand-held unit oval search head (with batteries): 2.5 kg approx
Shipping weight: 3.4 kg
Length
min: 920 mm
max: 1,260 mm
Power supply: 3 × 1.5 V D size batteries or rechargeable

Status
In production. In service in many countries world-wide.

Contractor
Vallon GmbH.

Vallon VMH3S metal and UXO detector

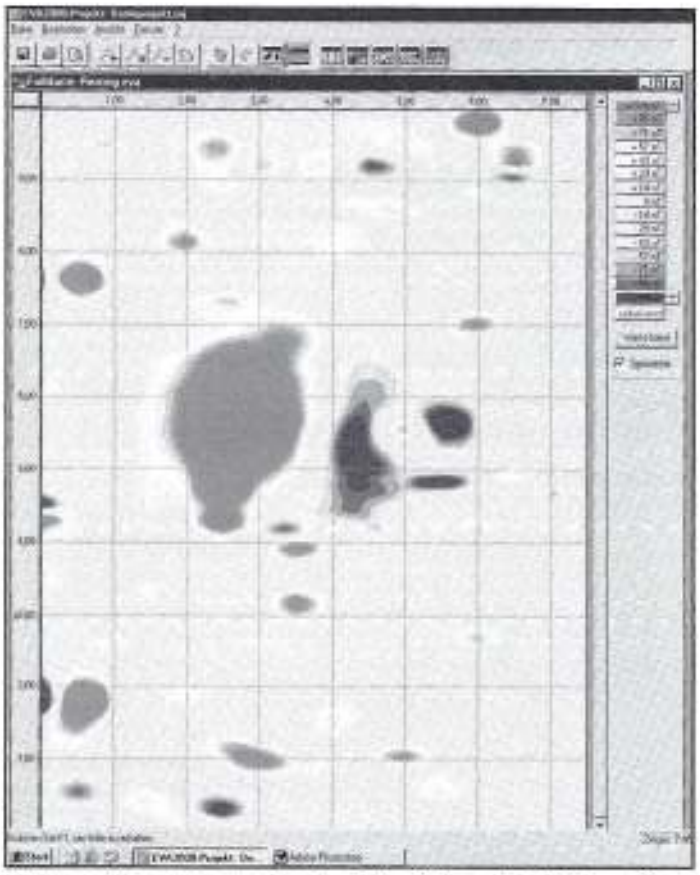
Description
The Vallon VMH3 has been designed for the detection of all types of ferrous and non-ferrous metals, such as metallic mines, plastic mines with minimal metal content, shells, UXO, ammunition and other metal objects in the ground or in shallow water. It has two interchangeable search heads; an oval head for detection up to 1 m deep and a large UXO search head (615 mm in diameter) for detection up to 1.8 m deep.

Modern Digital Magnetic Pulse Induction (DMPI) technology and an ergonomic design facilitate extended operating times. The VMH3S is designed to provide enhanced detection sensitivity and detection stability in all soil and water conditions. Different soil programmes make it effective in areas with severe laterite conditions or single mineralised stones.

The electronics are designed to withstand all typical environmental and vibration requirements and meets MIL STD 810E. Detected metal objects are clearly indicated by audio signal, 12-element LED bar graph and vibrator in the electronics housing. The operator can select individual alarm indications; clear alarms enable the operator to work without a headset.

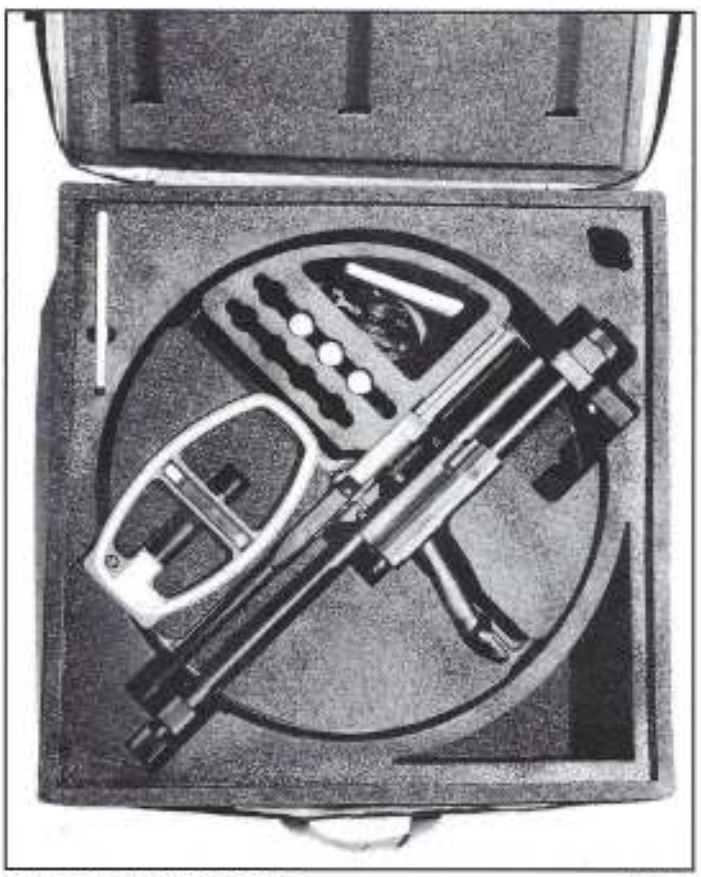
Automatic continuous self-check and automatic detection level control maintain sensitivity over hours of continuous operations and independently of battery level, temperature and other environmental conditions.

Operator controls are limited to a one-mode selector with two soil programmes and three push buttons for sensitivity level, audio signal volume and compensation/ground balance. The detector can be used with minimal operator training.



Colour object map produced with Vallon EVA2000® software (Vallon) 0074461

Vallon metal detector VMH3S with large UXO search head (Vallon) 0573862



Semi-hard carrying case (Vallon) 1041296

The telescopic carrying bar is adjustable from 1,090 to 1,692 mm depending on the search head. An oval search head facilitates operation in difficult and dense vegetation, rocks, shallow water and mud. It is also claimed to provide precise pinpointing and excellent separation between narrowly placed metal objects. In a minefield scenario the large UXO search head may be deployed for deeper buried targets after surface clearance of anti-personnel and anti-tank mines using the oval search head.

The VMH3S can be connected to the Vallon Memo Box MB4, Vallon Field Computer VFC1 or a laptop with Vallon EVA2000® software (see separate entries) via a watertight data output port for computer-aided detection using the large search head. Update of operation software and adaptation to individual requirements are possible.

The VMH3 is supplied with a semi-hard carrying case, which can be used as a backpack.

Specifications

Weight, hand-held unit
oval search head (with batteries): 2.73 kg
large UXO search head (with batteries): 3.27 kg
Shipping weight (with two search heads): 10.42 kg
Working length (oval search head)
min: 1,090 mm
max: 1,674 mm
min: 1,108 mm
max: 1,692 mm
Power supply: 3 × 1.5 V D size batteries or rechargeable

Status

In production. In service in many countries world-wide.

Contractor

Vallon GmbH.

Vallon metal detector VMH3S with oval search head (Vallon)
0573664

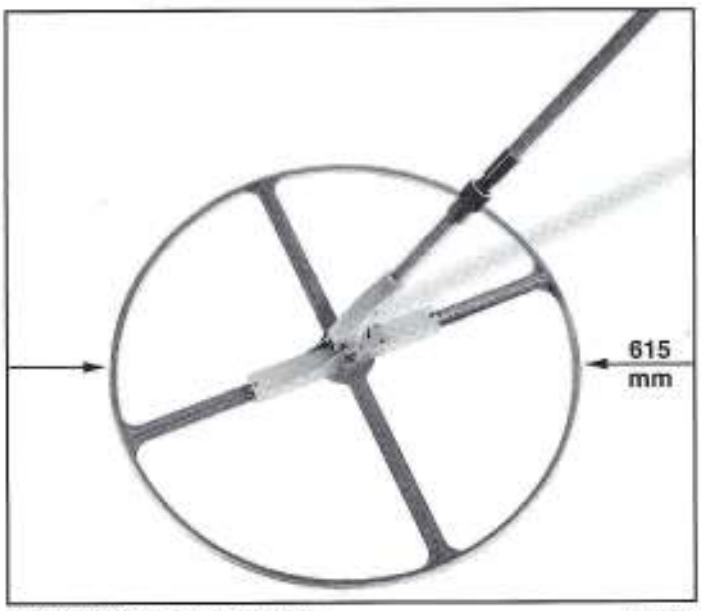
Vallon VMM3 metal detector

Development

The VMM3 has been designed for the detection of all types of ferrous and non-ferrous metals, such as metallic mines, plastic mines with minimum metallic content, shells, UXO, ammunition and other metal objects in the ground or in shallow water.

Description

The detector has a rigid design with a lightweight hand-held unit and can be operated with two interchangeable search heads or with a stick probe.



VMM3 UXO search head (Vallon) 0074455

VMM3 with standard search head (Vallon) 0074454

The working length is adjustable up to 1,924 mm. The electronics unit is normally carried by the operator, but can be attached to the telescopic pole as well.

The electronics are designed to withstand all typical environmental and vibration requirements and meets MIL STD 810E. Digital Magnetic Pulse Induction (DMPI) technology and an ergonomic design facilitate extended operating times. The VMM3 is designed to provide enhanced detection sensitivity and detection stability in all soil and water conditions. Different soil programmes make it effective in areas with severe laterite conditions or single mineralised stones.

The length of the telescopic pole is adjustable from 995 to 1,924 mm. An oval search head facilitates operation in difficult and dense vegetation, rocks, shallow water and mud. It is also claimed to provide precise pinpointing and excellent separation between narrowly placed metal objects. In a minefield scenario the large UXO search head (615 mm in diameter) may be deployed for deeper buried targets after surface clearance of anti-personnel and anti-tank mines using the oval search head. The large search head extends the detection depth to a maximum of 1.8 m. The optional stick probe can be connected for detection in bushes or trees.

Data input allows for further upgrade of the detector software, and data output enables computer-aided quality assurance following manual demining and evaluation of the measured results using the Vallon EVA2000® software to produce true-to-scale maps. The detector can also be connected to the Vallon Memo Box MB4 and the Vallon Field Computer VFC1 data loggers (see separate entries).

Specifications

Weight
hand-held unit (with batteries): 1.7 kg
operational detection set: 3.2 kg
Shipping weight: 11.5 kg
Working length
max: 995 mm
min: 1.924 mm
Power supply: 4 × 1.5 V D size batteries or rechargeable
Battery life: 50–60 h, with 22 Ah battery
Operating temperature: -32°C to +63°C
Storage temperature: –51°C to +71°C
Sweeping speed: 0.2–1 m/s

Status

In production. In service in many countries worldwide.

Contractor

Vallon GmbH.

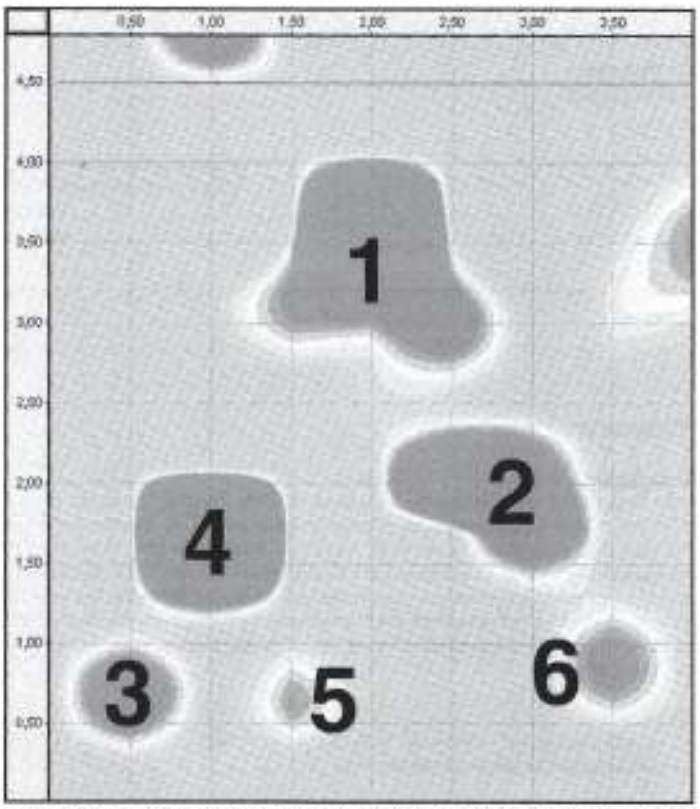
VMM3 stick probe (Vallon) 1041290

Vallon VMX3 metal and UXO detector

Description

The Vallon VMX3 detector is designed for the detection of all types of ferrous and non-ferrous metals, such as metal mines, plastic mines with minimal metal content, shells, UXO, ammunition and other metal objects in the ground or in shallow water. The large round search head allows for detection depths of up to 1.8 m. Trained operators can start detection work in less than 30 seconds. Due to the high penetration

Vallon metal detector VMX3 (Vallon GmbH) 0573284



Colour object map produced using EVA2000 software®. No. 1 = 50 kg aerial bomb at 1.7 m depth and No. 2 = 75 mm tank grenade at 1.2 m depth (Vallon) 0074467

depth the search head is typically swept in a 10 to 15 cm height above the surface.

The VMX3 uses Digital Magnetic Pulse Induction (DMPI) technology and is designed for the detection of both ferrous and non-ferrous ordnance in strongly mineralised soil where the performance of standard magnatometers is degraded.

The modern electronics withstand all typical environmental and vibration requirements and meets MIL STD 810E. The electronics unit is normally carried by the operator but can be attached to the telescopic pole as well. The VMX3 is equipped with a loudspeaker allowing the operator to work without a headset.

The search head, which is mounted to the telescopic pole, is lightweight, watertight and non-magnetic and contains the DMPI sensor with integrated noise reduction features. The high penetration depth of the search head allows it to be swept at a height of 100 to 150 mm above the surface. This enhances operation in difficult terrain including rocky areas and dense vegetation without loss of sensitivity.

The operating length of the VMX3 can quickly be fully adjusted from 920 mm to 1,370 mm.

Data input allows for further upgrade of the detector software, and data output enables measured data to be evaluated using Vallon EVA2000® colour software, running on a laptop or personal computer. The detector can also be connected to the Vallon Memo Box MB4 and Vallon Field Computer VFC1 data loggers (see separate entries).

Specifications

Search head diameter: 615 mm
Weight, hand-held unit (with batteries): 1.9 kg
Shipping weight: 7.6 kg
Working length
max: 1,370 mm
min: 920 mm
Power supply: 4 x 1.5 V D size batteries or rechargeable
Battery life: 35–40 hours depending on battery type
Operating temperature: –32°C to +60°C
Storage temperature: –55°C to +75°C

Status

In production. In service in many countries worldwide.

Contractor

Vallon GmbH.

Vallon VXV4/VXV8 multisensor vehicle

Description

The Vallon VXV4/VXV8 sensor platform was developed for the detection of UXO over large areas of land and replaced the earlier VEV3 multisensor vehicle (see separate entry). The vehicle incorporates an array of up to four standard ferrous locators (can be up to 8 sensors) operating with a Vallon Field Computer VFC1 (see separate entry) as data logger; other special vehicles are required to carry the locators on or under water.

To relate the exact x-y co-ordinates to the measured data, the Vallon sensor positioning system (SEPOS®) or a GPS receiver with antenna and a GPS reference station can be connected.

After the survey operation, all data is transferred to a laptop or personal computer and evaluated using the Vallon EVA2000® software package (see separate entry).

Specifications

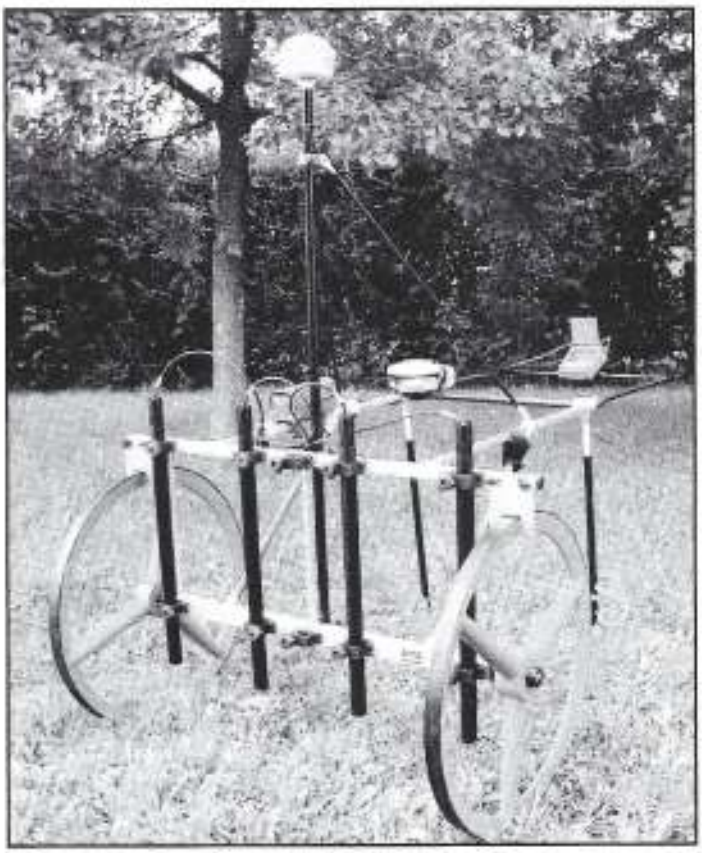
Weight (vehicle and 4 sensors): 30 kg
Dimensions of vehicle
length: 2.20 m
width: 1.33 m
Power supply: 1 set of accumulators (12 V 9.2 Ah)
Detection depth: up to 6 m

Status

In production. In service with many commercial EOD organisations.

Contractor

Vallon GmbH.



Vallon multisensor vehicle VXV4 with VFC1 and GPS (Vallon) 0573282

Iraq

Mansour-7

Description

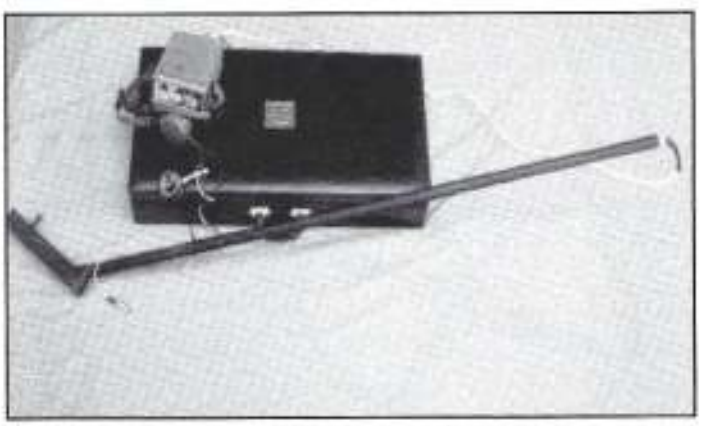
The Mansour-7 was primarily designed to detect buried metallic mines and the metal components of plastic-bodied mines at depths between 50 and 400 mm. The detector is probably based on the Russian IMP (see separate entry). The Mansour-7 has a linear search head attached to the tubular handle (which can be broken down during transit). The control box is carried by the operator and connected by cable into the end of the handle; signals are transmitted to a set of headphones. A carrying case is also provided.

Status

Currently unknown, although the Mansour-7 has been used in past operations by the Iraqi armed forces.

Contractor

Iraqi state factories.



The Mansour-7 mine detector showing the main components 0511650

Israel

BETA BMD-34

Description

The BETA BMD-34 metallic solid-state detector is a sensitive, sophisticated, miniature detector which can be used to detect any conductive material, ferrous or non-ferrous, in both magnetic or non-magnetic soils.

The detector comprises a search head mounted on the end of a telescopic handle, a belt-carried electronic control unit and a headset for the audible output signal. As an optional extra, a visual display can be clamped on the telescopic handle. The visual display consists of a 40 mm diameter meter with a central zero and a self-illuminating scale.

The controls consist of an on/off switch, search head balance knob and the battery check toggle switch. The detector is designed to require minimal adjustment during operation and features an automatic compensation for variables such as search head characteristics, amount of magnetic material in the soil, and temperature variations.

The detector has been designed for military use under severe environmental conditions; it is immersion-proof in 2 m of water, shock and vibration proof and has electromagnetic interference protection.

Specifications

Weight of equipment ready for use: 2.9 kg
Detection capability: (metallic AT mine) 300 mm
Operating temperature range: –15 to +72°C

Status

Production is believed to have ceased.

Contractor

BETA Engineering and Development Limited.

BETA BMD-34 metallic mine detector in use
0511851

Italy

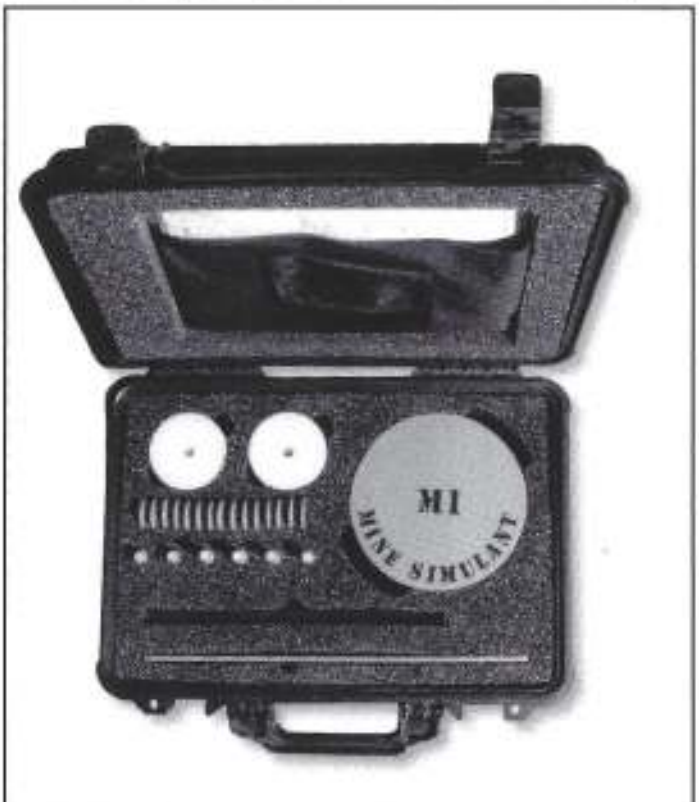
CEIA metal detector accessories

Description

Optional accessories for CEIA detectors (see separate entries) include:

Training Aid Materials and Support CEIA provides complete support for technical and operational courses, given by certified personnel, either on site or at its own premises. The curriculum includes first and second line maintenance, training for operators and a course for operator instructors. The teaching activities are backed up by full documentation, and are divided between classroom seminars and practical work in the field.

MIL-D1 Remote Programmer The Remote Programmer unit has been designed to control selectable operating parameters and to upgrade the software of the MIL-D1 metal detectors. This operation takes approximately 3 minutes and it can be performed in the field. The operation of this device does not require dedicated batteries.



Test Sample Kit (CEIA SpA) 0561834

MIL-D1 Remote Programmer (CEIA SpA) 0561833

Technical Maintenance Tool Kit The Maintenance Tool Kit is a self-contained tool kit designed specifically for MIL-D1 maintainers. It includes all those tools required for maintenance or repair.

Training Mine Set The Training Mine Set includes various reference samples representing mine detonators, designed for testing the detection of samples at different depths. It is intended to assist in training of various detection techniques and is also suitable for testing various mine detectors. The kit is supplied with Certification of Conformity to the Primary Reference Sample.

Status
In production and in service.

Contractor
CEIA SpA.

Technical Maintenance Tool Kit
(CEIA SpA)
0561632

CEIA MIL-D1 digital metal detector for ground search applications

Description
The MIL-D1 is a portable, high-sensitivity metal detector designed to detect magnetic and non-magnetic metals in conductive and non-conductive soils, including laterite and those containing magnetite. The detector comprises a light detection head, telescopic handle and electronics unit. It is supplied with a canvas carry-bag and high-impact polypropylene case. The electronics unit can be an integral part of the telescopic handle, carried over the shoulder or attached to a belt using special hooks. The wiring is designed to be protected against any possible damage.

The MIL-D1 detector does not require manual calibration, and optimum sensitivity over all terrain types is provided by CEIA's Automatic Soil Compensation System. Localisation of metal objects is undertaken by a two-tone audible pinpointing system that allows the position of the detected mass to be identified accurately. The detector is manufactured in compliance with the ISO-9001 standard.

Optional accessories include MIL-D1 Remote Programmer, Training Mine Set and Technical Maintenance Tool Kit (see separate entry).

Specifications
External diameter of probe head: 280 mm
Handle to search head adjustable distance: from 400 to 1,620 mm (head included)
Electronics Unit: 215 × 155 × 80 mm
Weight
probe head and telescopic handle: 1.6 kg
electronics unit (including batteries): 1.6 kg
carry-bag: 1.1 kg
carrying case: 7.7 kg
Battery type: 4 × ANSI standard size D, 4 × 1.5 V alkaline (LR20), 4 × 1.2 V NiMH rechargeable
Operation time (default search programme)
alkaline batteries: 65 h at 20°C
Ni-MH (9,000 mA/h) rechargeable batteries: 40 h at 20°C
Storage temperature: –55 to +75°C
Operating temperature: –46 to +65°C
Case dimensions: 950 × 440 × 155 mm
Environmental compliance: exceeding MIL-STD-810E(F)
Protection level:
MIL-D1: IP68 (IEC 60529)
polypropylene case: IP68 (IEC 60529)

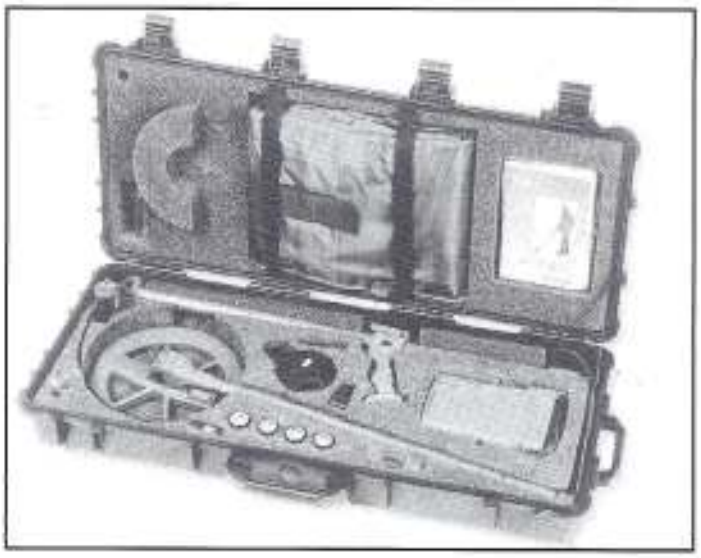
MIL-D1 digital metal detector for ground search applications
(CEIA SpA)
1041120

CEIA MIL-D1 in operation in Laos
(CEIA SpA)
1325186

Status
In production and in service. More than 70,000 CEIA metal detectors have been supplied to various customers, including consignments to Colombia, Egypt, Finland, France, India, Pakistan, South Africa, Sri Lanka, Sweden and Vietnam.

Detectors for humanitarian demining programmes have been supplied to Afghanistan, Angola, Bosnia-Herzegovina, Burundi, Cambodia, Chad, Croatia, Djibouti, Eritrea, Ethiopia, Iraq, Lebanon, Mozambique, South Africa, Sudan, Thailand and Vietnam.

Contractor
CEIA SpA.



MIL-D1 detector in transit case (CEIA SpA)
0580716

CEIA MIL-D1/DS deep search underground metal detector

Description
The CEIA MIL-D1/DS deep search underground metal detector is an active electromagnetic induction (EMI) device based on the transmission of an alternated, low frequency magnetic field and the reception of the variations introduced in the magnetic field by buried metal masses.

The detector comprises a telescopic tube with a central section of aluminium and glass-fibre extensions. The two probe-antennae which transmit and receive the magnetic field are mounted at the ends of the extensions. Target indication is by LCD on the front panel of the control unit and an acoustic warning signal with adjustable volume control. Other features include a battery charge indicator and the detector is supplied with a high-impact polypropylene case.

Optional accessories offered by CEIA include the MIL-D1 Remote Programmer, Training Mine Set and Technical Maintenance Tool Kit (see separate entry).

MIL-D1/DS UXO metal detector (CEIA SpA) 0580718

MIL-D1/DS inside its transportation case (CEIA SpA) 1345933

MIL-D1/DS in use in Laos (CEIA SpA) 1041121

Specifications
Sensitivity: adjustable
Battery type: 4 × ANSI standard size D, 4 × 1.5 V alkaline (LR20), 4 × 1.2 V Ni-MH rechargeable (7,000 mA/h)
Probe head external diameter: 280 mm
Telescopic handle length: 1.6 m
Electronics unit dimensions: 215 × 155 × 80 mm
Weight
probe head and telescopic handle: 3.9 kg
electronics unit (including batteries): 1.6 kg
carrying case: 7.7 kg
Storage temperature: –55 to +75°C
Operating temperature: –46 to +65°C
Case dimensions: 950 × 440 × 155 mm
Protection level
MIL-D1/DS: IP68 (IEC60529)
Polypropylene case: IP68 (IEC60529)

Status
In production and in service. More than 70,000 CEIA metal detectors have been supplied to various customers, including consignments to Colombia, Egypt, Finland, France, India, Pakistan, South Africa, Sri Lanka, Sweden and Vietnam. Detectors for humanitarian demining programmes have been supplied to Afghanistan, Angola, Bosnia-Herzegovina, Burundi, Cambodia, Chad, Croatia, Djibouti, Eritrea, Ethiopia, Iraq, Lebanon, Mozambique, South Africa, Sudan, Thailand and Vietnam.

Contractor
CEIA SpA.

Classic walk-through metal detector

Development
The Classic walk-through metal detector was designed to meet the specific security needs of government agencies, schools, hotels, amusement parks, public events and nightclubs.

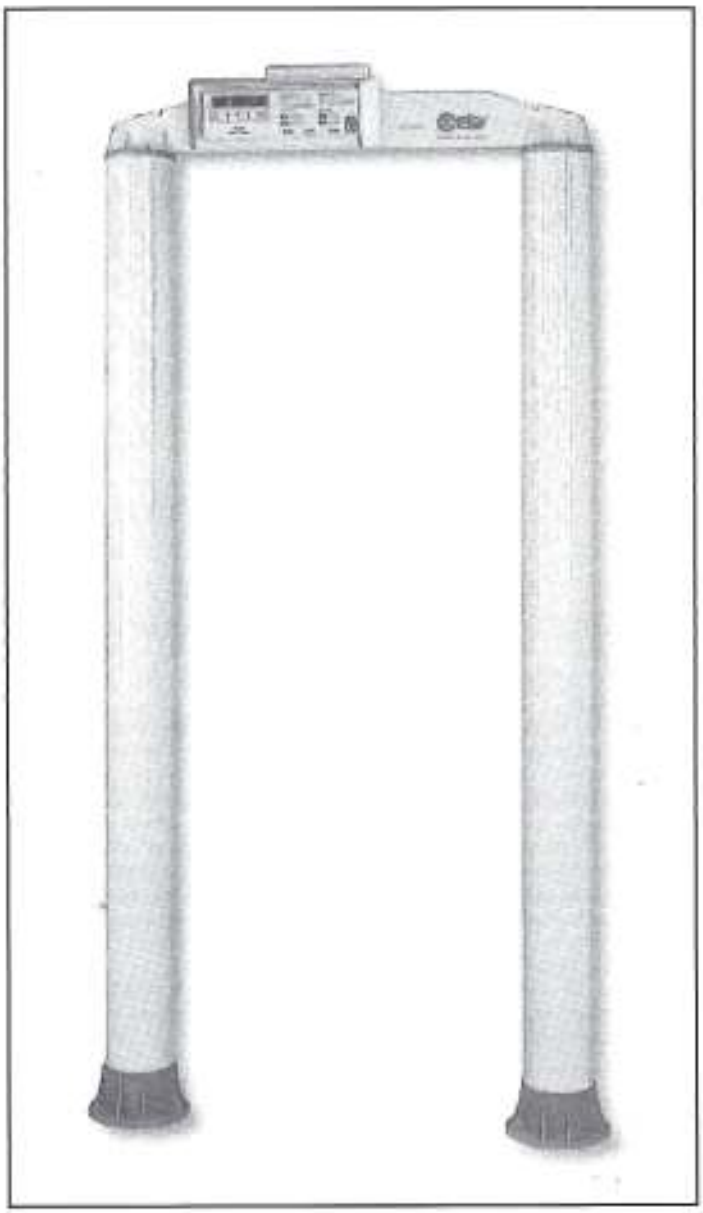
Description
The Classic walk-through metal detector is compact, lightweight and portable. The security equipment does not require any specialist training which makes this metal detector 'user friendly'. The Classic conforms to all International Safety Standards and is capable of detecting both magnetic and non-magnetic weapons. The metal detector is digitally adjustable. All functions are programmable and controlled by a microprocessor. Programming access is protected by a hardware key. The control unit is incorporated into the detector.

The Classic complies with regulations relating to pacemakers, defibrillators and other vital support systems. It complies with EC Regulations and International Standards relating to Electrical Safety and Electromagnetic Compatibility (EMC).

Specifications
Height:
(total) 2,255 mm
(without electronics unit) 2,050 mm
Width:
(inner) 720/820 mm
(outer) 835/935 mm
Power supply: 100/115/230 V AC, +10/-20%, 45 ÷ 65 Hz, 20 VA max
Operating temperature: –20°C to +70°C
Storage temperature: –35°C to +70°C
Relative humidity: 0 to 95% (without condensation)

Status
In production.

Contractor
CEIA SpA.

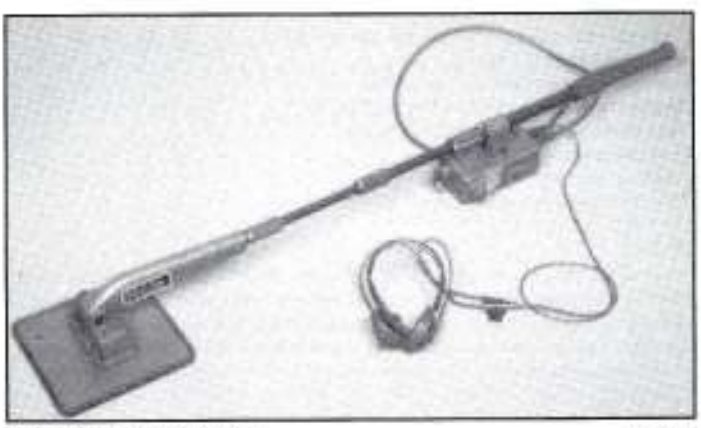


Classic walk-through metal detector (CEIA SpA)
1298762

Korea, South

NMD-9 and GDS-17 detection sets

Description
Developed by the Agency for Defence Development of Korea, the NMD-9 is a rugged, solid-state portable locator capable of detecting metallic and minimum-metal mines. The GDS-17 is used for the detection of metal objects only. These detectors appear to have been copied from early US-designed instruments, such as the AN/PSS-11 and AN/PRS-7 (see separate entries).



NMD-9 mine detection set 0511652

The search head of the NMD-9 generates and radiates a continuous wave RF signal and receives and demodulates the resultant signal for aural presentation in a headset. The GDS-17 uses a pulse induction detection system.

The search head is encased in a rubber cover and is mounted on the end of a long telescopic carrying handle, which also mounts the control box. The control box contains the system electronics on a single board and the battery, which has an operating life of 15 hours continuous use in the NMD-9, and 28 hours in the GDS-17. The control box also has a 'search' switch used to locate the general presence of a target. A 'point' mode with three varying degrees of sensitivity can then be selected.

Specifications
NMD-9
Weight
in use: 4 kg
in carrying case: 10.8 kg
Length of telescopic handle: 540 to 1,460 mm
Battery voltage
NMD-9: +15 V/–15 V
GDS-17: +12 V
Dimensions of carrying case: 600 × 380 × 200 mm

Status
Believed to be no longer in production.

Contractor
Gold Star Electric Company Limited.

Russian Federation

IMB metal detector

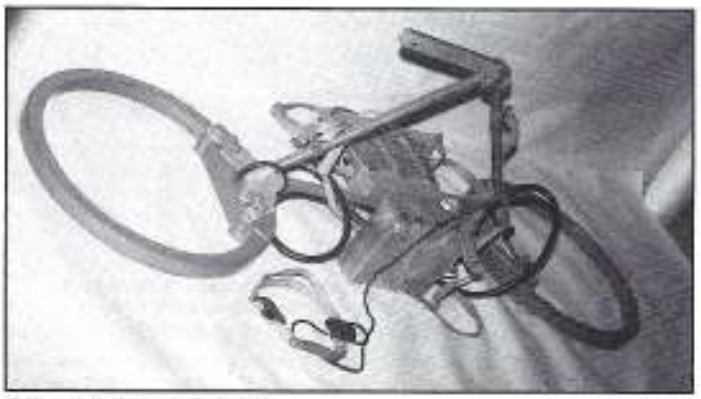
Description
The IMB detects large metallic objects lying at depths in excess of 2 m. It has a built-in control system and is powered by four storage batteries. The detector can be operated for 4 hours continuously at an ambient temperature of +15°C on one set of batteries.

The detector is delivered complete with packing boxes and a boxed set of spare accessories.

Specifications
Weight of sensor unit: 10.3 kg
Total weight: 19 kg
Operating temperature range: –50 to +50°C

Status
Status uncertain.

Contractor
Tomsk Measuring Apparatus Factory.



IMB metal detector (Tomsk) 0021485

IMP and IMP-2 detectors

Description
The IMP and IMP-2 were designed to detect both metallic objects and minimum-metal mines. The detectors consist of the detector head assembly, a four-piece search handle, tuning box (which is combined with the battery pack), power supply (which consists of four 1.6 V batteries) and the headphones.

When dismantled, all the components are carried in a lightweight rectangular metal box. The detector head assembly consists of two transmitting antennas and a receiving antenna, all encased in a Bakelite cylinder (417 mm long × 38 mm diameter). The handle consists of four aluminium sections which, when joined together, are 1.58 m long. One or more of these sections can be removed to reduce the length of the equipment for use in confined areas. The tuning box, or amplifier, consists of five transistors and associated components mounted in a lightweight metal box, with the tone regulator mounted on the top. The detector is supplied with handle, elbow-rest, metal case, soft cover, carrying strap for use with the case or cover, feeler handle with bar and battery carriers.

The main advantage of the IMP over earlier Soviet detectors is that the equipment can be used under water to a maximum depth of 1 m. IMP-2 is smaller overall than the IMP, much lighter, and may be powered by several types of battery. It also has a longer telescopic handle, a rectangular head and is generally more sensitive.

A commercial model based on the IMP-2 and known as the PR-507 is no longer manufactured (see separate entry).

Specifications
IMP-2
Weight of detector head: 2 kg
Handle length: 830–1,500 mm
Detector head dimensions: 200 × 200 × 10 mm
Processor unit dimensions: 195 × 130 × 45 mm
Operating temperature range: –50 to +50°C

IMP-2 components (Tomsk) 0021487

IMP mine detector in use on construction site 0512209

A Ukrainian soldier with an IMP-2 detector in southern Lebanon (Colin King) 0074206

SECTION 4

Detection ranges
Copper coin (1 g): 80–100 mm
Gold wedding ring: 200 mm
Steel nail (70 × 3 mm): 120 mm
Steel needle: 90–100 mm
7.62 mm pistol: 400 mm
Steel disc (300 mm diameter): 400–600 mm

Status
In service with the Russian Federation and Associated States (CIS) and some other nations, including Bangladesh (60 IMP).

Contractor
Tomsk Measuring Apparatus Factory.

AKA series of metal detectors

Description
The STT Group manufactures a number of metal detectors for the professional market. These include the handheld AKA 7202M and AKA 7215M detectors; the 7202M has a high scanning speed of up to 50 cm/sec, the user scanning the inspected individual at a distance of between 15 and 25 mm, and a high sensitivity to small metal objects. It has a shock-proof design and a model with built-in LED torch is also available from the manufacturer. The 7215M is similar in design and is able to discriminate between ferrous and non-ferrous metals.

STT also produces the AKA 7252 and AKA 7260M portable metal detectors. The former has user-friendly interfaces and a rapid start-up procedure. The latter has a waterproof search head and water-tight main unit, automatic and manual ground compensation system and an automatic detection threshold correction system (to minimise external and internal interference from factors such as humidity, partial battery discharge and so on). Dynamic mode is used for rapid searching, while the static mode is best utilised for precise localisation of a target. User pre-sets for different applications, such as EOD, demining or improvised explosive device detection, can be stored and recalled from files into the device's flash memory. Various accessories are available with the package, such as a 12 V vehicle charger, rechargeable batteries, headphones, spare coil and a rugged carry case.

Specifications
AKA 7202M
Dimensions: 415 × 85 × 35 mm
Weight: 410 g
Alarm indication: visual, auditory
Power supply: 9 V battery
Operating temperature: –10 to +40°C

AKA 7252 (STT Group) 1178148

AKA 7260 (STT Group) 1178150

AKA 7202 (STT Group) 1179344

AKA 7215 (STT Group) 1179346

AKA 7252
(STT Group)
1178144

AKA 7260
(STT Group)
1178148

AKA7215M
Dimensions: 415 × 85 × 35 mm
Weight: 410 g
Alarm indication: visual, auditory
Power supply: 9 V battery
Operating temperature: –15 to +45°C
Operating time from full battery: 40 h

AKA 7252
Dimensions, main unit: 138 × 108 × 75 mm
Telescopic bar, maximum length: 1,200 mm
Search head: 210 or 260 mm
Weight: 2.1 kg
Auditory alarm: 4 tones
Power supply: 12 V rechargeable battery
Operating temperature: 0 to +50°C
Operating time from full battery: up to 16 h

AKA 7260M
Dimensions, main unit: 138 × 108 × 75 mm
Telescopic bar, maximum length: 1,200 mm
Search head: 210 or 260 mm
Weight: 2.1 kg
Auditory alarm: up to 9 tones
Power supply: 12 V rechargeable battery
Operating temperature: –20 to +50°C
Operating time from full battery: 5–12 h

Status
Available.

Contractor
STT Group.

MMP metal detector

Description
The MMP electromagnetic induction metal detector is designed for the detection of objects containing metal materials in a non-conducting or poorly conducting medium. The MMP is a portable device comprising a search head, telescopic bar, processing unit, supply unit and headphones. The automatic tuning system is capable of detecting metal objects in different types of soil of any water content, as well as in brickwork, snow and salt or fresh water up to a depth of 1 m.

Specifications
Detection range
1 g copper coin: 80–100 mm
70 × 3 mm steel nail: 120 mm
300 × 3 mm steel disk: 400–600 mm

Operating temperature: –50 to +50°C
Dimensions
search head: 200 × 200 × 10 mm
telescopic bar length: 830–1,500 mm
processing unit: 195 × 130 × 45 mm

Status
Available.

Contractor
Russian state factories.

PR-507 metal detector

Description
The portable PR-507 metal detector operates on the induction principle and was designed to detect objects with a minimal metal content. The detector head is square and mounted on the end of a telescopic carrying handle, which can be varied in length from 0.83 to 1.5 m. Other components include a processing unit, headphones and a battery box. Power is supplied by a 9 V battery, although various other lower voltage battery combinations can be utilised. The detector can be used over snow and water (both fresh or salt) up to 1 m deep.

Specifications
Detector head dimensions: 200 × 200 × 10 mm
Handle length: 830–1,500 mm
Processor unit dimensions: 195 × 130 × 45 mm
Operating temperature range: –50 to +50°C

Detection ranges
Copper coin (1 g): 80–100 mm
Gold wedding ring: 200 mm
Steel nail (70 × 3 mm): 120 mm
Steel needle: 90–100 mm
7.62 mm pistol: 400 mm
Steel disc (300 mm diameter): 400–600 mm

Status
Production ceased.

Contractor
Tomsk Measuring Apparatus Factory.

SMD-300 selective metal detector

Development
The SMD-300 is designed for the detection and identification of metal targets. It is intended to be used to search metal housings for covert surveillance devices within a building, including walls and furniture.

Description
A built-in data signal processor and data processing algorithm enables targets to be detected, even when large 'false' responses are received from other metal objects. The received signal responses are processed and the results displayed on an LCD display using either a digital or graphic presentation, and an audible tone is delivered through headphones.

The detector can evaluate the form of metal targets to differentiate between flat and volumetric objects. It can also estimate the embedded depth of detected targets, evaluate the mean cross-sectional dimensions and estimate the metal layer width. Two targets can be analysed simultaneously.

SMD-300 selective metal detector (STT Group) 1179347

Specifications
Receiver
sensitivity: 10 µV
dynamic range: 80 dB
Detection range for 50 × 50 mm metal box
in non-reinforced wall: up to 300 mm
in reinforced wall: up to 150 mm
Power supply: 6 V (2 battery packs)
Battery life: 6 h continuous operation
Dimensions
antenna head diameter: 260 mm
main unit: 200 × 135 × 65 mm
device in carrying case: 550 × 320 × 260 mm
Weight
handle with antenna head: 0.3 kg
main unit: 2 kg
ready to use (with battery): 2.5 kg
device in carrying case: 6.5 kg

Status
In production and in service.

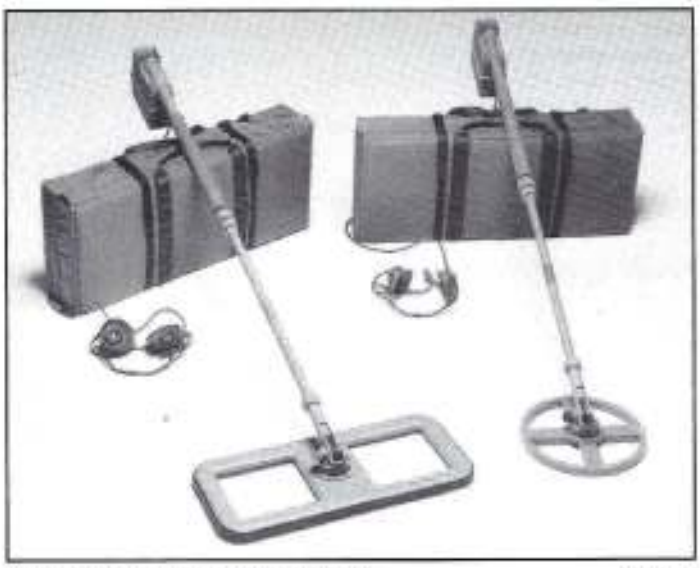
Contractor
STT Group.

South Africa

MIDAS pulse induction metal detector

Description
The MIDAS pulse induction metal detector is a self-contained, lightweight detector with self-nulling and confidence-tone features. It uses a 3-part modular construction to minimise maintenance and has three user-selected sensitivity levels (high, medium and low) to ensure early and accurate target acquisition. MIDAS can work continuously for up to 28 hours powered by a 16.5 V alkaline battery (or up to 11 hours with standard cells); an alarm is given when the battery is low.

Foam-filled Kevlar™ search heads are made in both rectangular and round configurations. Optional heads can be made to a size or shape to suit customer requirements. The head is mounted on a telescopic handle, constructed using wound phenolic resin-impregnated glass fibre cloth, that can be extended to a maximum length of 2.11 m. Fully closed the length is 1.64 m but the most commonly used operating length is 2 m. The electronics unit and battery holder is at the top end of the handle, secured in such a way that it counterbalances the weight of the search head and handle.



MIDAS pulse induction mine detectors 0511853

Specifications
Weight (with large head): 4.3 kg
Large head dimensions: 633 × 288 mm
Round head diameter: 305 mm
Length overall, extended: 2.11 m
Length overall, closed: 1.64 m
Max reach from centre of gravity: 1.76 m
Min reach from centre of gravity: 1.22 m
Operational temperature range: –25 to +60°C

Status
No longer in production.

Contractor
Formerly manufactured by Barcom Electronics (Pty) Limited.

Turkey

MD-710 mine detector

Description
The MD-710 detector has a high scanning performance and detection sensitivity and is produced for military applications.

The detector is designed to locate ferromagnetic materials as well as ferrous and non-ferrous metals and can be used on land and under shallow salt or fresh water. The MD-710 is easy to use and compensates automatically for the ground or water characteristics.

The detector has a rigid construction with a lightweight, glass fibre telescopic carrying rod. A handle and elbow rest allow one-arm operation. The electronics unit can be carried either on a belt or using a shoulder strap. The detector has two modes: dynamic and static.

The equipment is supplied with a transit case and textile backpack for field use.

Specifications
Sensitivity: 0–10 stepless adjustment, automatic continuous ground compensation
Detection range
275 mm diameter mine: 365 mm
78 mm diameter mine: 80 mm

Sweeping speed: 0.1–1 m/s
Operating temperature: –35 to +55°C
Storage temperature: –55 to +85°C
Dimensions
search coil diameter: 190 mm
telescopic bar: 900–1,750 mm
electronics unit: 80 × 100 × 185 mm
Weight
search coil and handle: 1.525 kg
complete operational set including electronics box: 3.365 kg
complete set with accessories: 8 kg

Power supply: 4 × 1.5 V mono cells or 4 × 1.24 V Ni/Cd accumulators
Battery charger: input voltage 220 V ± 20% (optional quick recharge)

Status
In production.

Contractor
Yüksek Teknoloji Elektrik Elektronik Makine Sanayi ve Ticaret AS.

MD-720 mine detector

Description
The MD-720 detector has a high scanning performance and detection sensitivity and is produced for military applications.

The detector is designed to locate anti-personnel mines, UXO, ferrous-magnetic materials and ferrous or non-ferrous metals either on or below ground. The MD-720 can also be used in shallow fresh or salt water; the detector compensates automatically for ground or water characteristics.

The detector has a rigid construction with a lightweight, adjustable, glass-fibre, telescopic carrying rod. Technical failure or low battery is signalled by an audio and visual alarm. A handle and elbow rest allow one-arm operation. The electronics unit can be carried either on a belt or using a shoulder strap. The detector has two modes: dynamic and static.

The equipment is supplied with a transit case and textile backpack for field use.

Specifications
Sensitivity: 0–10 stepless adjustment, automatic, continuous ground compensation
Detection range
275 mm diameter mine: 365 mm
78 mm diameter mine 80 mm
Sweeping speed: 0.1–1 m/s

Interference: min distance of 1.3 m between detectors
Operating temperature: –35 to +55°C
Storage temperature: –55 to +85°C
Dimensions
oval search coil: 170 × 305 mm
telescopic bar: 960–1,900 mm
electronics unit: 95 × 75 × 205 mm
Weight
search coil and handle: 1.650 kg
complete operational set including electronics box: 4.720 kg
complete set with accessories: 8.114 kg
Power supply: 4 × 1.5 V mono cells or 4 × 1.24 V Ni/Cd accumulators
Battery charger: input voltage 220 V ± 20% (optional quick recharge)

Status
In production.

Contractor
Yüksek Teknoloji Elektrik Elektronik Makine Sanayi ve Ticaret AS.

United Kingdom

Guartel MD4 metal detector

Description
The MD4 metal detector was developed in collaboration with the UK Ministry of Defence and is specifically designed for the detection of Improvised Explosive Devices (IED) and for EOD operations, although it may also be used for mine detection and clearance.

All of the electronics, controls, detection head and batteries are contained within a hand-held probe. There are only two operating controls, ON/ZERO and OFF. The operating principle is multisampling pulse induction, with detection indication given either by a built-in speaker or an earpiece. The equipment is fully ruggedised, waterproof and compatible with electronic countermeasures; sensitivity is claimed to be high.

The MD4 is NATO codified and supplied packed into a shockproof aluminium transit case with a soft carry case, an earpiece attachment, and a spare battery cassette.

Target location is by audio signal which varies in pitch and volume according to the proximity of the target.

Specifications
Weight: 2 kg
Length: 1.23 m
Diameter: 39 mm
Battery life: 12–14 h
Batteries: 4 × alkaline C cell

MD4 metal detector in use (Guartel)
0023970

Status
In production, NATO codified.

The MD4 is in service with the British Army and other (undisclosed) organisations.

Contractor
Guartel Technologies Limited.

Guartel MD8 *plus* minimum-metal detector

Description
The MD8 *plus* is a high-sensitivity detector claimed by the manufacturer to be capable of detecting all currently known minimum metal mines. High-speed pulse induction technology is used to allow the detection of minimum-metal mines even when they are in close proximity to larger metal objects, making it suitable for both military countermine and humanitarian demining operations. It is claimed that a Type 72 anti-personnel mine can be detected at 100 mm, a TMA at 200 mm and a hand grenade at 700 mm.

The MD8 *plus* is available with either halo or probe heads. The power supply, electronics and search head are all incorporated into a single aluminium housing. The open halo has a sighting bar that allows targets to be pinpointed to within millimetres. The detector is ruggedised, waterproofed and is compatible with most electronic countermeasures. The power supply maintains a constant voltage to the electronics, utilising the full capacity of the cells.

MD8 plus in soft case (Cliff Wright) 0568665

The detector comes in an impact-resistant transit case and is supplied with a lightweight carrying case, spare batteries and an earphone.

Specifications
Total operating weight: 2.17 kg
Max operating length: 1.5 m
Min operating length: 1.05 m
NATO stock number: NSN 6665-99-727-8434
Battery type: 3 'C' type alkaline manganese dry cell
Battery life: approximately 12 hours continuous
Detection: Audio by volume and pitch
Claimed detection performance
Min metal mines: Type 72 (AP) 100 mm min; TMA 200 mm min
Large metal target (grenade): 700 mm

Status
In production and used by military & NGOs worldwide.

Contractor
Guartel Technologies Limited.

MD8 plus with halo head (Cliff Wright) 0568664

Guartel MD2000 metal detector

Description
The MD2000 metal detector is a multirole, hand-held instrument for the detection of ferrous and non-ferrous objects. The equipment operates on the pulse induction principle and may be used with probe heads in addition to the normal halo search heads. Recent upgrades have improved sensitivity and the equipment has been further ruggedised. The MD2000 is easy to operate, being completely automatic in operation and requiring no tuning for different ground conditions. The search heads may be operated immersed in water with no adjustment.

The full field pack is supplied with two search probes, a halo search head, a loudspeaker and earpiece, and the control unit which houses the batteries, packed into a weather-resistant soft carry case. A 'short pack' may be specified for open ground clearance, in which the probes are omitted.

The MD2000 can be operated using dry cells or rechargeable batteries.

Specifications

	Dimensions	Weight
Field pack complete	1,030 × 400 × 80 mm	6 kg
Short field pack (less probes)	1,020 × 400 × 75 mm	4.5 kg
Electronic pack (with batteries)	250 × 172 × 42 mm	1.9 kg
Telescopic handle assembly	860 (min)–1,600 (max) mm	1.0 kg
1 m search probe	1,000 × 42 mm	0.7 kg
Short baton probe	450 × 42 mm	0.6 kg

Status
NATO codified. In production. In service with the British Army, police forces and similar authorities worldwide.

Contractor
Guartel Technologies Limited.

MD2000 metallic mine detector with 300 mm loop in use (Guartel) 0068051

MD2000 in use with search probe (Guartel) 0023981

Hawk 450 XD Non-Linear Junction Detector (NLJD)

Description

The Hawk 450XD 'Electronic Device Detector' is widely used in EOD search operations to detect hidden electronic devices such as remotely activated receivers and timing and power units of improvised explosive devices (IEDs), regardless of whether the device is radiating, hard-wired or turned off.

The XD is used by EOD search teams, police forces and professional sweep teams and is currently in operational service with NATO, the European Commission, the US Army and the UK MoD.

The Hawk 450XD gives both visible and audible alerts when a positive detection is made, is battery powered, weighs less than 2 kg but is robust with a fibre glass and carbon design, and is simple to operate. Using continuous wave transmission, it is able to discriminate between signals from true electronic targets and innocent returned signals.

Specifications

Weight: 5.6 kg (including kit)
Transmitter
Frequency range: Four spot frequencies in the range of 869–916 MHz
Power output: 2 mW to 1W ERP (2 and 4 W options)
Frequency range: 1,738–1,832 MHz
Sensitivity: detection at –130 dBm
Battery: 10.8 V DC/1,700 mAh
Operating time: 2 hours
NATO stock no: 6665-99-445-9337

Status

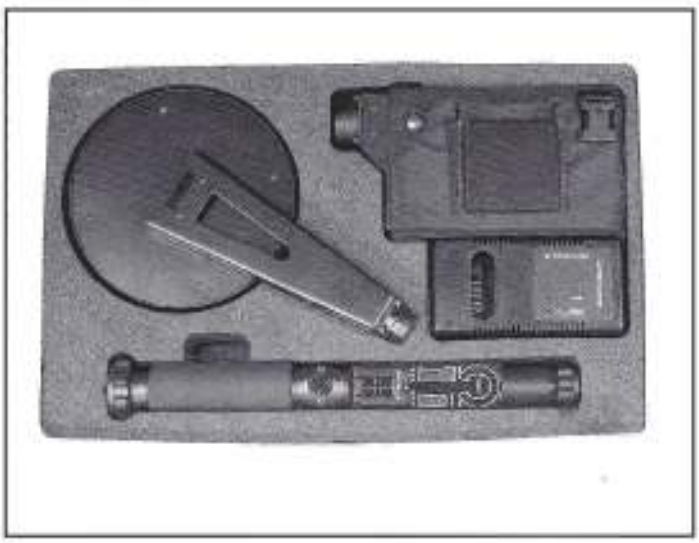
In production.

Contractor

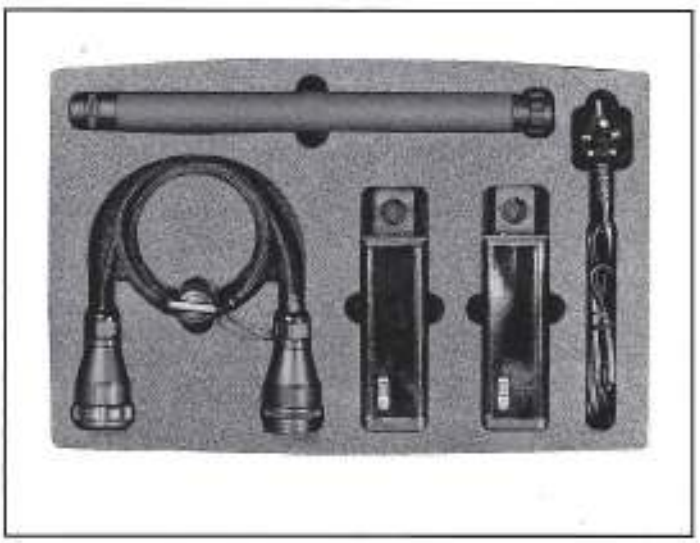
Winkelmann (UK) Limited.

Hawk 450XD configurations (Winkelmann (UK) Ltd) 1168214

Hawk 450XD (Winkelman (UK) Ltd) 1168218



450XD in case (bottom) (Winkelmann (UK) Ltd) 1180360



450XD in case (top) (Winkelmann (UK) Ltd) 1180361

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Hawk XDi Non Linear Junction Detector (NLJD)

Description
The Hawk XDi Electronic Device Detector is widely used in Explosive Ordnance Disposal (EOD) search operations to detect hidden devices such as timing and power units of improvised explosive devices (IEDs), regardless of whether the device is radiating, hard-wired or turned off. It can detect explosive devices containing electronic components such as: remote control receivers, mobile phones, electronic timers, clocks, transceivers, electronic fuses and delayed-action units. The device can also be successfully deployed to detect buried weapons, ammunition, engineering mines and hidden arms caches. Users include: bomb technicians, special forces, military and non military personnel.

The Hawk XDi allows the bomb technician to search voids and areas where they are unable to gain physical or visual access, in order to detect electronic components and determine if the area is free from an IED. The equipment would generally be used inside buildings, but may be operated in vehicles, aircraft, outdoors, or in terrains ranging from urban areas, to deserts and mountain regions.

Specifications
Weight: 9.3 kg (including kit)
Transmitter
Frequency range: 10 spot frequencies in the range of 869-916 MHz
Power output: 2 mW to 2 W/8 W ERP (0 dBm to 33/39 dBm ERP)
Sensitivity: detection at –133 dBm
Battery: 10.8 V DC/1,700 mAh
Operating time: 1.5 hours
Detection range:
(corrosive) not less than 0.5 m
(electronic) not less than 1 m

Status
In production. Deployed in Afghanistan, Iraq and Ireland.

Contractor
Winkelmann (UK) Limited.

Hawk XDi (Winkelmann (UK) Ltd) 1168222

Hawk XDi combo (Winkelmann (UK) Ltd) 1168220

Hawk XDi in case (Winkelmann (UK) Ltd) 1168219

MD5D Cloverleaf hand-held metal detector

Development
The MD5D is based on the MD1 metal detector. The designation 'D' stands for digital technology.

Description
The MD5D offers digital functions (self-test, audio/visual), automatic adjustment, dynamic/static search operation, clear audio alarm (tremolo effect when adjacent metal objects are detected), battery monitor and under voltage cut-out when operating on rechargeable batteries. The search characteristics of the MD5D can be modified to suit user needs.

Specifications
Dimensions:
(search head) 170 × 115 mm
(weight) 280 g
(length) 420 mm
Operating time: 35 h
(with 9 V PP3 battery, alkaline 10–15 h with rechargeable NiMH-PP3 battery)
Operating temperature: –5°C to +50°C

Status
In production. In service in airports and prisons.

Contractor
Todd Research Limited.

MD5 Cloverleaf hand-held metal detector (Todd Research Ltd) 1298764

No 4C mine detector

Description

The United Scientific Instruments No 4C mine detector was the standard mine detector of the British Army from 1968; it has recently been replaced by the EBEX-420 PB (see separate entry). Earlier models were the No 4 and No 4A. The No 4C comprises a search head mounted on a telescopic handle, an amplifier unit, headphones and connecting cables. For transport, the equipment is disassembled and carried in a wooden case which also contains the spare battery, test boxes, extension cables and other accessories.

The search head contains two mutually reacting inductance coils. Inductance is adjustable by means of a dust core trimmer assembly; when correctly adjusted, the mutual inductance of the two coils is in balance. When any metal component is brought within the field of the coils, the balance is distorted, resulting in an oscillating difference potential. This is then amplified by the amplifier unit and fed to the earphone as a distinctly audible signal.

There are two modes of operation, one for detecting metallic mines in normal soil and the other for detection in heavily mineralised ground, or if there is likely to be metallic contamination on the surface. The mode of operation is selected by a switch on the amplifier unit.

During use, the telescopic pole is extended, and one end is strapped to the forearm while the other is attached to the search head. The amplifier unit (which also contains the batteries) is clipped to the operator's belt, and both the search head cable and earphone lead are connected to the unit.

The detector can be used by the operator in either the standing, or prone position, with the search head adjusted to keep it parallel to the ground during clearance operations.

Specifications

Weight of detector in transit case: 14.4 kg
Transit case
Length: 533 mm
Width: 254 mm
Height: 203 mm

Search head
Weight: 1.8 kg
Length: 285 mm
Width: 185 mm
Height: 108 mm

Telescopic handle
Weight: 1.15 kg
Length
collapsed: 380 mm
fully extended: 1.28 m

Component parts of the No 4C mine detector 0611654

Amplifier unit
Weight with battery: 1.8 kg
Length: 216 mm
Width: 108 mm
Height: 108 mm

Battery type: 9 V dry cell PP6 or equivalent
Current consumption: 3.3–3.6 mA
Operational life of battery: 300 h of intermittent use
Detection capacity
Detection depth
British Mk 7 anti-tank mine
Normal ground: 510 mm
Magnetic soil (pavé): 320 mm

Status

No longer in production and no longer in service with the British Army. Believed to be in service with several other countries.

Contractor

United Scientific Instruments plc.

RE 300 Selective Metal Detector

Development

The RE 300 Selective Metal Detector was designed for the detection and identification of metal targets. It is used to search for metal enclosures which might be shielding covert surveillance devices such as radio microphones, microphone amplifiers and other electronically controlled devices such as Improved Explosive Devices (IEDs), within building fabric, walls, furniture and so on.

Description

The built-in data processor (DSP) and special data processing algorithm allows for the detection of targets even when large 'false' responses are received from other metal objects.

The RE 300 has the capability to evaluate the form of metal targets in order to differentiate between flat and volumetric objects. It also has the means to estimate the embedded depth of detected targets. If there is one flat object, the device evaluates the distance between its sensor and the object. If there are two, it calculates the distance to each one. The metal detector can estimate the metal layer width of the detected target and if there are one or two flat objects the device assesses their metal layer width.

Specifications

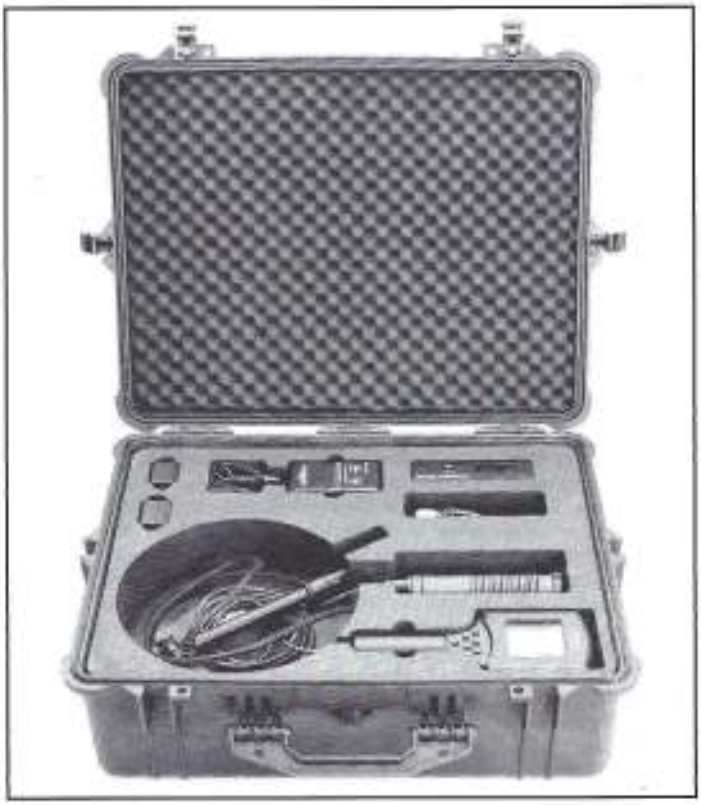
Dimensions
Antenna Module: 260 mm diameter
Transceiver Module: 299 × 135 × 65 mm
Device in carrying case: 616 × 494 × 220 mm
Weight
Antenna Module: 0.3 kg
Transceiver Module: 2 kg
Ready-to-use device (with battery): 2.5 kg
Device in carrying case: 11 kg

RE 300 Selective Metal Detector
(Richmond EEI Ltd)
1334705

Performance
Receiver sensitivity: 10 μV
Dynamic range of sensor: 80 dB
Detection range for metal box (50 × 50 mm):
(regular walls) up to 300 mm
(reinforced walls) up to 150 mm
Accuracy of depth definition: 10%
Display: LCD
Power requirements
Battery: 6 V (2 packs)
Operating time: 6 h

Status
In production.

Contractor
Richmond EEI Ltd.



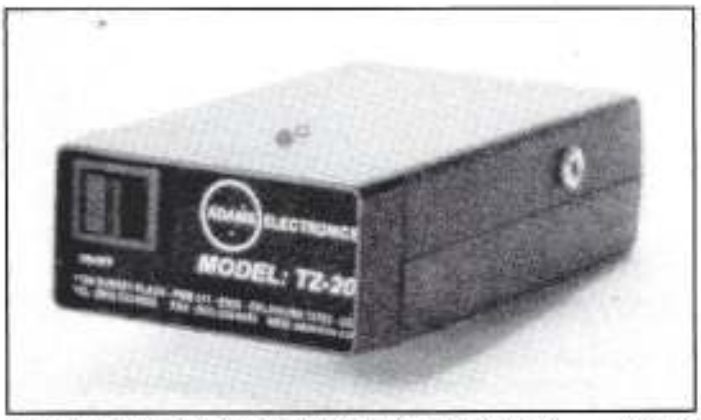
RE 300 Selective Metal Detector In transportation case (Richmond EEI Ltd)
1334704

TZ-20 palm-held metal detector

Description
The TZ-20 is a lightweight pocket-size metal detector and is the first of a new range of products to incorporate Adams Electronics' fully integrated Active Probe Technology (APT).

The APT system makes the new detector suitable for a wide range of applications including general personnel screening and pinpointing objects buried in walls, floors and ceilings of buildings or other structures. The detector is simple to use and has a microprocessor-controlled battery management system to give greatly extended battery life. An earphone jack is also provided.

Specifications
Dimensions: 115 × 65 × 30 mm
Weight: 225 g (approximate)
Sensitivity: target size 0.1 g
Operating temperature: –20 to +65°C
Storage temperature: –30 to +80°C
Power supply: 9 V block battery MN1604 or equivalent alkaline, disposable or rechargeable.
Operating time: 360 h at +25°C (alkaline battery)
Alarm indication: piezo audio alarm and high intensity LED; earphone jack socket



The TZ-20 pocket-sized metal detector (Adams Electronics) 0074394

Status
In production.

Contractor
Adams Electronics (International) Limited.

White's Electronics AF 108 military mine detector

Description
White's Electronics (UK) Limited is a subsidiary of White's Electronics Inc and, with the co-operation of several governments and military advisers, has produced a modern military mine and bomb detector. The unit is extremely sensitive to both very small objects (such as firing pins), and large objects (such as bombs). This sensitivity remains constant until the batteries are discharged. Mineralised soil and saltwater have little or no effect on sensitivity levels as the unit is designed to compensate automatically for these conditions. The equipment produces virtually no DC magnetic field. Both visual and audible indications of metal are provided (the visual element can be on the search head if required).

The robust aluminium control box is waterproof and weighs 1 kg. There are only three controls: on, push auto-tune and a lockable audio threshold control. Three Light Emitting Diodes (LEDs) are used to indicate: unit faults, when batteries need replacing and when batteries are approaching the end of their operational life. There is also an audio alert system that operates in conjunction with the LEDs. The box is carried in a weatherproof canvas bag on a shoulder strap or belt loops.

An aluminium battery box contains four 1.5 V type D alkaline manganese batteries with an operational life of approximately 70 hours at 20°C. Normally, the battery box is carried next to the control box but an extension lead allows it to be kept under clothing in very cold conditions. The empty battery box weight is 530 g.

The three-piece rod set carries a 280 mm search coil which can operate when submerged. The rod length can be varied from 1.6 m down to 596 mm and has a handgrip and armrest, both of which are adjustable.

White's Electronics military mine detector (White's Electronics) 0023961

The equipment is completed by a waterproof headset, which can be worn over or under a helmet. All the components can be carried in a special shoulder bag, which also holds an extra battery box and spares.

Two probes are available as accessories to this equipment. One is 1 m long and the other 400 mm; both may be used under water.

Specifications
Total weight: (in use) 4.61 kg
Total weight: (complete) 11.42 kg
Temperature range: –40 to +85°C
Claimed detection sensitivity
Steel strip: (50 × 12.5 × 1 mm) 350 mm
Aluminium sheet: (20 × 40 mm) 320 mm
Metal anti-tank mine: (diameter 200 mm) 800 mm
Coil spring: (23 mm long, diameter 7.1 mm) 90 mm
Ball-bearing: (diameter 4.7 mm) 80 mm
Aluminium cap: (6.5 mm long, diameter 5.9 mm) 120 mm
Steel pin: (10 mm long, diameter 1.5 mm) 140 mm

Status
No longer in production. The AF 108 has seen service with Chile, Malaysia, Norway, Tunisia, the US Marine Corps, United Nations' forces and many other countries.

Contractor
White's Electronics (UK) Limited.

United States

AN/PRS-7 non-metallic mine detector

Description
The AN/PRS-7 (company designation is the 4D6) was developed by the US Army, with production being undertaken by Fourdee Inc. It is a simple, rugged solid-state equipment capable of detecting most minimum-metal Anti-Tank (AT) and Anti-Personnel (AP) mines.

The AN/PRS-7 consists of four major components: search head, handle, control box and headset.

The mine is detected by the field of the square search head assembly, which consists of two transmitting antennas, one receiving antenna and wires which run inside the handle to the control box. The search head generates and radiates a continuous wave RF signal and receives and demodulates this signal. A rubber bumper is mounted around the search head as a protective measure.

The telescopic handle, which is detachable from the search head, can be extended from 0.482 to 1.752 m. The handle is normally used in the standing position with the search head about 1.2 m away from the operator's body. The detector head can also be swivelled to allow the operator to use the equipment while prone.

The control box, which is mounted on the handle, consists of the signal processing board with its associated electronic components, the battery and the controls. The latter features a 'search' mode which is used to locate the presence and general position of the mine. The exact position is determined in the 'point' mode, using any of the sensitivity levels. The mine detector will discriminate and work effectively on both magnetic and non-magnetic soil and on terrain covered with other debris. The AN/PRS-7 performed well in the Far East, Europe and the USA, but when confronted with minimum-metal mines in desert soils, as found in the Middle East, the response was poor.

The presence of a mine is indicated audibly to the operator through the headset assembly, consisting of two headphones which produce a 1,000 Hz signal.

The AN/PRS-7 mine detector is supplied with spare battery and hinge bolt, arctic warming case for the battery, carrying case, and operating and maintenance handbooks.

Specifications
Weights
mine detector: 4.082 kg
complete equipment in case: 10.886 kg
Case
length: 615 mm
width: 406 mm
height: 184 mm

Left: AN/PSS-11 metallic mine detector; right: AN/PRS-7 non-metallic mine detector (US Army) 0511657

Audio frequency of headset: 1,000 Hz
Battery voltage: 16.2 V
Battery type: mercury
Battery life: 28 h continuous operation
Battery capacity
+ also ordered by section 0.5 Ah
– section 1.8 Ah
Operating temperature range: –31.7 to +51.7°C
Storage temperature range: –53.9 to +68.3°C
Relative humidity operational: 95%
Relative humidity storage: 100%

Status
Withdrawn from service with the US Army, but still in service with many other armed forces. By 1979, Fourdee had delivered over 30,000 mine detectors to various countries. The AN/PRS-7 was replaced by a product-improved version, the AN/PRS-8 (see separate entry).

Contractor
Fourdee Inc.

AN/PRS-8 metallic and non-metallic mine detector

Description
In FY76 the US Army Mobility Equipment Research and Development Command (MERADCOM) initiated an AN/PRS-7 Product Improvement Program (PIP) with the Cubic Corporation Defense Systems Division. Under this programme, the detector was improved using new solid-state electronics and signal processing equipment for better mine detection in any type of soil. The designation AN/PRS-8 was assigned to the detector. The new solid-state transmitter and receiver sweeps over a wide radio frequency band instead of the single frequency of the earlier AN/PRS-7, and provides an order of magnitude increase in the search head data gathered. This is then processed by a single-board processor module fitted with a 16-bit microprocessor and memory on a single chip. The algorithm used was developed from that used on the AN/VRS-5 vehicle-mounted mine detector system (now cancelled) and resulted in a vastly increased performance over the AN/PRS-7, specifically in a higher detection rate and fewer false alarms.

The detector adapts its threshold sensitivity to various soils automatically. Handling characteristics have been improved with end-point blanking to eliminate false alarms produced by the operator's tendency to tilt the search head at the ends of the swing, a metronome pacing signal to set the optimum search sweep rate, and more distinctive audio signals. An automatic switch from 'search' to 'point' is also included.

In late 1981, a USD7.3 million contract was placed for 1,461 AN/PRS-8 detectors. The contract included retrofit kits to update 9,500 AN/PRS-7 detectors in service to AN/PRS-8 standard.

Specifications
Search head assembly
Weight: 770 g
Length: 221 mm
Width: 221 mm
Height: 56 mm

Control box (without battery)
Weight: 857 g
Length: 180 mm
Width: 64 mm
Height: 78 mm

Battery
Weight: 250 g

Length: 95 mm
Width: 38 mm
Height: 65 mm

Long handle
Weight: 620 g
Length: 480 mm
Height
nested: 35 mm
extended: 1.46 m

Short handle
Weight: 110 g
Length: 300 mm
Width: 30 mm
Height: 56 mm

Miscellaneous (headset, cables, straps and so on)
Weight: 1.2 kg Carrying case
Weight
without unit: 6.2 kg
with unit: 10 kg
Length: 600 mm
Width: 400 mm
Height: 190 mm
RF frequency range: 300–600 MHz
Audio frequency
search mode: 1 click/2.5 s
point mode: 3–150 clicks/s
Temperature range
operating: –32 to +52°C
storage: –55 to +70°C

AN/PRS-8 hand-held mine detector
0511658

Battery complement: Type BA-5847 (lithium)/U
Battery voltage: +5.6 V nominal
Battery life: 20 h at ambient room temperatures

Status
Withdrawn from service with the US Army.

Contractor
Cubic Corporation, Defence Systems Division.

AN/PSS-11 Metallic Mine Detector

Description
The AN/PSS-11 was developed by the US Army with production being undertaken by Cubic Corporation's Defense Systems Division. The work involved was carried out under contract to the US Army Mobility Equipment Research and Development Command (MERADCOM), now the Night Vision and Electronic Sensors Directorate.

The AN/PSS-11 is produced under licence in Egypt by the Benha Company for Electronic Industries, Cairo, under the designation MMD2000.

The AN/PSS-11 is a simple, rugged, solid-state metallic mine detector which can detect anti-tank and anti-personnel mines containing ferrous and non-ferrous metals.

The equipment consists of five major components: detection head, telescopic handle, control box, receiver/transmitter and headset.

The detection head is square and contains four coils which are electrically balanced. These transmitter coils set up a magnetic field with a radius of 0.914 to 1.219 m. When a metallic object is encountered, the magnetic field is distorted, which results in an imbalance in the mutual inductance bridge.

The receiver/transmitter, which is carried in a pouch on the operator's belt, amplifies the imbalance and causes a signal increase in the headset to indicate the presence of the metallic object. A phase discriminating circuit cancels false signals caused by salt water or magnetic soils, and only those signals caused by metallic objects are transmitted to the headset.

The control box is on the handle and 'nulls' the signal to the headset to establish initial balance condition. The detector has low, intermediate and high sensitivity selections to locate metallic objects and pinpoint their exact positions.

The telescopic handle, which is detachable from the detector head, can be extended from 0.482 to 1.752 m. It is identical to the handle on the AN/PRS-8. The handle is normally used in the standing position with the search head about 1.2 m from the body. The detector head can also swivel to allow the operator to use the equipment while prone. The headset consists of two headphones which produce a tone of 625 Hz.

A complete AN/PSS-11 set consists of a carrying case, mine detector, spare modules, spare batteries, Arctic kit and operations and maintenance handbook.

AN/PSS-11 in use in Egypt, where it is known as the MMD2000
(Colin King)
0022726

Specifications
Weight: 10 kg
Case
length: 600 mm
width: 400 mm
height: 180 mm
Audio frequency of headset: 625 Hz
Battery voltage: 10.7–14 V
Battery type: BA-1568/U
Battery life: 70 h continuous operation
Detection capability
small metal object 304–355 mm
large metal object: 1.219–1.828 m
Operating temperature range: –32 to +52°C
Storage temperature range: –55 to +70°C
Relative humidity operational: 100%
Relative humidity storage: 100%

Status
Withdrawn from service with the US Army and replaced by the PSS-12 (see entry on Schiebel AN-19/2 under Austria in this section). Ordered by Egypt (USD4.5 million contract 1983, now licence production). Known to be in service in Brazil.

Contractor
Cubic Corporation, Defence Systems Division.

AN/PSS-14 (formerly the Hand-held Standoff Mine Detection System – HSTAMIDS)

Description

The AN/PSS-14 (which was known as the Hand-held Standoff Mine Detection System, or HSTAMIDS), has been developed for the US Army under an engineering and manufacturing development (EMD) contract for a next-generation US Army mine detector.

The system combines ground penetrating radar (GPR) with metal detector technology and data fusion algorithms in order to detect both anti-personnel (AP) and anti-tank (AT) mines. It can operate over all soil types, including wet, dry, frozen, laterite (iron-rich), clay and sand. The data fusion algorithms allow the operator to discriminate between clutter and mines; the algorithms are based on terrain modelling, the model being continuously updated as the operator moves. The presence of a mine or mines is indicated by audible alert.

Operator controls and indicators are all located in the control grip and the lightweight design is compact and folds for ease of transport. A telescoping wand facilitates use in the standing, kneeling or prone position. A support sling can be used and the unit has been designed for operation when the user is wearing bulky NBC or cold-weather clothing. A small halo of infra-red light projected around the sensor head enables covert night operation and the system uses a standard military-issue battery carried in a case that can be clipped to the operator's belt.

The HSTAMIDS controls (Colin King) 1041152

Status

In production. In August 2006, L-3 Communications announced that L-3 CyTerra had been awarded a contract for the AN/PSS-14, as well as Sweep Monitoring Systems, Training Target Sets and training and support, by the US Army Communications-Electronics Life Cycle Management Command Acquisition Center – Washington. The contract covers a 10-year period, includes options, and has an anticipated value over the 10 years of over USD300 million. As of August 2006, more than 2,000 AN/PSS-14 sets had been delivered to the US Army and US Marines under a previous contract. As of April 2008, L-3 Communications announced that it is going to provide AN/PSS-14 sets and accessories to the US Army with the order totalling USD26 million and representing the fourth full-rate production contract. Since this contract was awarded in 2006, the total value of orders received exceeds USD90 million.

Contractor

L-3 CyTerra.

HSTAMIDS undergoing trials (Colin King) 1041151

EDIT-3 and EDIT-5 mine detectors

Development

The Electromagnetic wave Detection and Imaging Transceiver (EDIT) is a mine detector developed by Stolar. The EDIT was developed for the US Army as a Close-In Man-portable Mine Detector (CIMMD). The EDIT-5 has only recently become available.

Description

The EDIT-3 mine detector employs technology previously used in the mining industry – namely that of a Resonant Microstrip Patch Antenna (RMPA) to detect shallow, buried metallic and non-metallic objects. The results of any scan are immediately displayed on the LCD screen of a PDA, as well as by way of audible tone indication. EDIT-5 consists of a handgrip, telescopic pole, sensor head, battery pack and a PDA. These fit together quickly and easily, in order to meet the development goal of an easily transportable mine detector that requires no external connector attachments. Various sensitivity options can be selected for the sensor head, which sweeps at a height of between 1 and 6 inches above the terrain surface. The EDIT-5 model includes more enhanced thermal stability and signal-to-noise (S/N) ratio than the EDIT-3 model, as well as upgrade options for a sub meter accurate head tracking system. The manufacturer claims it has a minimal response to background clutter.

Specifications

Search head (rectangular): 17.7 × 16.5 × 3.8 cm
Working length: 0.45–1.42 m
Weight
search head: 1 kg
hand-held unit: 1.8 kg
battery pack: 0.9 kg
transport case (alone): 2.7 kg
Power supply: Rechargeable 2-cell or 1-cell lithium ion pack, 16 V DC
Operating time: 6–8 hours, depending on image processing
Operating temperature: 0 to +60°C
Storage temperature: –16 to +60°C

Status

Available.

Contractor

Stolar Research Corporation.

GA-72Cd magnetic locator

Description
The GA-72Cd is a versatile, magnetic locator designed to aid law enforcement officers during area search operations. It is designed to enhance an organisation's detection capability and reduce the time required for finding ferrous metal parts from improvised explosive devices (IEDs), buried ordnance and covered weapons.

The manufacturer claims that the GA-72Cd has a substantially greater detection range than conventional metal detectors and its light weight makes it the ideal instrument for searching in rocky terrain, undergrowth, swampy areas, shallow creeks and snow-covered areas.

The system incorporates a digital readout and expanding bar graph displays of signal strength and polarity. In addition there are two audio signal modes, four sensitivity settings and a piezoelectric speaker. There is a 60-hour operation cycle (intermittent usage) on two lithium 9 V batteries.

Specifications
Weight: 1.14 kg (2.5 lb) (approximate)
Operating temperature: –25 to +60°C (–13 to +140°F)
Overall length: 87.6 cm
Waterproof length: 53.3 cm
Nominal sensor spacing: 35.6 cm
Construction: rugged, all solid-state

Status
In production and in worldwide service.

Contractor
Schonstedt Instrument Company.

GA-72Cd
0518563

GA-92XT magnetic locator

Description
The GA-92XT is a versatile, highly portable magnetic locator used by the US Army to locate unexploded ordnance (UXO) and improvised explosive devices (IEDs) in the Middle East. It is also used by law enforcement organisations during search operations.

The unit detects the presence of ferrous metals (iron or steel) at distances of up to 3 m underground, depending on size and orientation. The GA-92XT is similar to other Schonstedt magnetic locators but with greater portability. It collapses to fit into a belt-mounted holster when not in use but extends to a full 660 mm for ease of use. Two models are available. The 'i' model includes both a battery and sensitivity indicator, while the 'd' model has both indicator and a bar graph display of the magnitude and polarity of the detected magnetic field.

Specifications
Weight: 1.1 kg (2.4 lbs)
Operating temperature: –25 to +60°C
Length, collapsed: 390 mm
Length, extended: 660 mm
Nominal sensor spacing: 240 mm
Operating time: 24 hrs (intermittent usage) on 1 lithium 9 V battery

Status
In production and in worldwide service.

GA-92XT (Chip Somodevilla/Getty Images) 1176376

Contractor
Schonstedt Instrument Company.

GEM-3 mine detector

Description
The GEM-3 was introduced by Geophex to the market in 1991 as a broadband electromagnetic metal detector. It was initially designed for the detection of unexploded ordnance on US military ranges and its application to mine detection was made relatively recently. The sensor system consists of a pair of concentric transmitter coils and a smaller, central receiver coil. An electronic console is attached to the other end of the boom. The GEM-3 detects and discriminates by way of multiple frequencies, the frequency selected dependent upon the target mine and local ground conditions. Electromagnetic Induction Spectroscopy, or EMIS, allows the identification of the mine type. Real-time identification can take place using windows-based software run either on a computer or palm. The GEM-3 is powered by a rechargeable battery which provides up to about 8 hours of sensor operation.

Specifications
Search head (circular): 25–40 cm
Working length: Up to 2.0 m

Weight
search head: 500 g
handheld unit: 3.0 kg
power supply: 0.8 kg
transport case (alone): 4.0 kg
Power supply: Rechargeable 12 V DC battery
Operating time: Up to 8 hrs, at optimal temperature
Operating temperature: –20 to +50 °C
Storage temperature: –20 to +50°C
Bandwidth: 300 Hz to 96 kHz

Status
In production and in service with the US government and EOD companies.

Contractor
Geophex.

Model G-858 MagMapper

Description

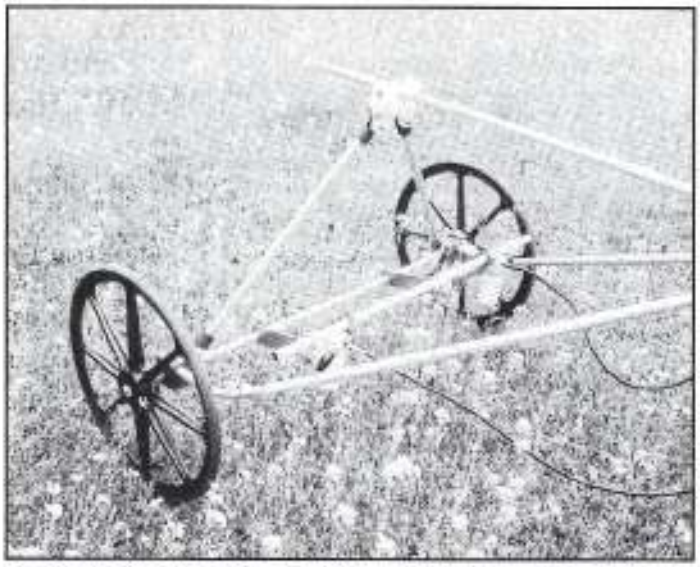
The Geometrics Model G-858 MagMapper employs caesium vapour technology originally developed for airborne magnetometer instruments. This is claimed to make the G-858 MagMapper about 10 times faster and more sensitive than conventional land magnetometers. The MagMapper combines the speed and precision of the caesium magnetometer with an easy-to-use data mapper console to make an instrument capable of detecting a few grams of ferrous metal or even voids or disturbances in the ground.

The G-858 MagMapper consists of a hand-held counterbalanced wand with a caesium magnetometer sensor at one end connected to a belt-mounted console and battery pack. The console has a high-resolution 320 × 200 pixel screen to display a map or, in stacked graph mode, about 1,000 data points. The console has all the necessary electronics to drive the sensor, to acquire the data and display it on the screen for review and edit and to store and transmit the data to a personal computer for further analysis. The G-858 is supplied ready for integration with Differential GPS for real-time navigation and data positioning which speeds later processing and target analysis. The MagMapper can also be configured on a hand-pulled cart for UXO location.

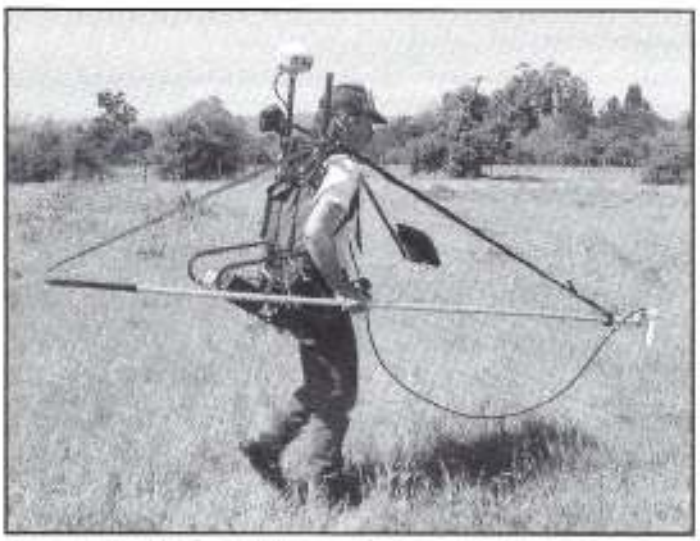
The fast response of the instrument – the system samples at a rate of approximately 10 times per second – means that data may be taken at a brisk walking pace. Up to a hectare of land may be surveyed every hour. The manufacturer claims the high sensitivity means many small targets, including small mines, will stand out clearly and unambiguously. In addition, Geometrics offers an add-on MetalMapper sensor that uses a Time Domain EM device for surveying for near surface conductors (brass, gold). Maps may be made showing aerial coverage and identifying target positions.

The MagMapper makes acquisition of field data a simple three-stage process. For the first stage, the user can visualise the area where the data is taken by setting up a view in the map mode. Secondly, during the survey the operator can see which portion of the map has been covered and the latest line of data. Thirdly, by switching to profile mode the operator can review the stacked lines of data or edit the data as required. During a survey the user is able to track his position as calculated by the instrument and displayed on a two-dimensional grid. The instrument may also be used in a search mode to look for anomalies using an audio output which can be adjusted so that the tone is proportional to the magnetic disturbance.

The instrument can store up to 8 hours of magnetometer or MetalMapper with GPS position data. Stored surveys are downloaded via an RS-232 port to a computer for analysis and display using Geometrics free MagMap2000 software package. MagMap plots survey positions, data profiles and generates contour maps for display and interpretation. Optional MagAid software determines target position, depth and size. The G-858 is shock resistant and the manufacturer claims it can be dropped 3 ft on a hard surface without damage.



MagMapper in cart configuration (Geometrics Inc) 0562951



Geometrics Model G-858 MagMapper (Geometrics Inc) 0097198

Specifications

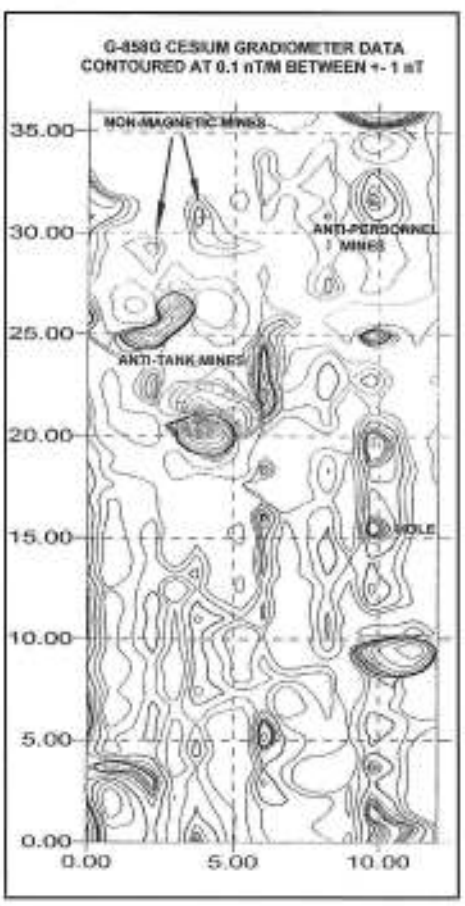
Length:
minimum: 1.22 m
maximum: 1.52 m
Weight:
wand: 1.8 kg
search head: 0.22 kg
transport case: 11.4 kg
Temperature:
operational: –10 to +50°C
storage: –20 to +70°C
Power supply: 24 V rechargeable battery pack. 4 gel cell 6 V batteries
Operating time: 6–8 hours per charge
Operating range: 20,000 nT to 100,000 nT
Water tight: to 0.9 m depth

Status

Available. There may be over 300 of these systems operational worldwide, the company estimating that a third of these are deployed for UXO detection.

Contractor

Geometrics Inc.



A magnetic contour map from data collected using a Geometrics Model G-858 MagMapper and depicting the presence of anti-tank and anti-personnel mines 0512684

Super Scanner

Description
This instrument is designed for reliable and effective detection of metal, weapons and contraband. Sturdy construction permits continuous use over extended periods by relatively untrained individuals.

Solid-state electronics, surface-mounted printed circuit boards and computer-designed circuitry ensure high sensitivity and dependability. A reduced sensitivity button allows effective operation at ankle level when scanning on certain types of floor. Super Scanner automatically retunes itself each time it is switched on and checks battery status. Audible and visible (LED) alarms indicate detection of any metallic object; an earphone is available for silent scanning.

Status
In widespread service in the US in 2009.

Contractor
Garrett Metal Detectors.

Super Scanner metal detector (Garrett Metal Detectors) 0535796

DETECTION EQUIPMENT – METAL DETECTORS (FIXED)

Canada

VE6000 Large Vehicle Bomb Detection System

Description
The VE6000 Large Vehicle Bomb Detection System was developed to detect large vehicle-bombs with a high vehicle throughput.

The VE6000 combines an automated touchless vehicle sampling system with Scintrex's patented GC/IMS chemical detection. This system is fully automated for continuous operation and is driven by an interface that is user-friendly. The VE6000 can be adapted to suit site-specific architectural and various threat detection requirements.

The system can be used in a variety of applications including: government facilities, military installations, transportation terminals, security establishments, embassies and nuclear facilities.

VE6000 Large Vehicle Bomb Detection System
(Scintrex Trace Corporation) 1299209

Specifications
Vehicle size:
width: 2.20 m
height: 2.25 m
length: 8 m
Throughput time: Typically >1 min (dependent on operational configuration)
Explosive detection capability: TNT, NG, AN, EGDN, o-MNT, p-MNT, DMNB Dynamite, smokeless powder and other commercially available explosives
Power requirements: 72 kVA, 3 phase, 575 V AC, 60 Hz (includes 2 kVA conditioned power)
10 kVA, 1 phase, 115 V AC, 60 Hz conditioned, UPS recommended

Status
In production and in service.

Contractor
Scintrex Trace Corporation.

Germany

Ebinger PASSEX® 100 M

Description
The Passex® 100 M metal-detecting gate is designed to be used for access control in a wide variety of circumstances such as restricted areas, conferences, exhibitions and for loss protection. The gate is constructed from tubular aluminium components, which also form the sensor. It can operate on battery or mains power.

During use a weak alternating current is induced into the gate, generating a low-strength magnetic field around it. Metal objects carried through this field will cause a drain of energy to the sensor which is measured and transformed by the detector electronics into an adjustable alarm signal. The device is equipped with automatic signal adaptor to ensure reliable and secure sensitivity calibration for extended use. The detector gate is only activated when a person enters the sensor area, reducing the risk of false alarms. The gate is also equipped with a person counter.

Specifications
Dimensions (approximate)
gate: 2,070 × 750 × 680 mm
electronics box: 90 × 90 × 240 mm
packed: 1,250 × 680 × 450 mm
Weight (with electronics): 10 kg
Power supply: 12 V, 1.3 Ah rechargeable battery or mains
Operational time (battery): 25 h
Charging time: 10 h
Charger: Pb-charger 0.5A
Alarm: 85 dB/30 cm

Status
In production and in service.

Contractor
Ebinger Prüf- und Ortungstechnik GmbH.

PASSEX® 100 M metal detecting gate
(Ebinger)
0074325

Ebinger PASSEX® 200/210 archway

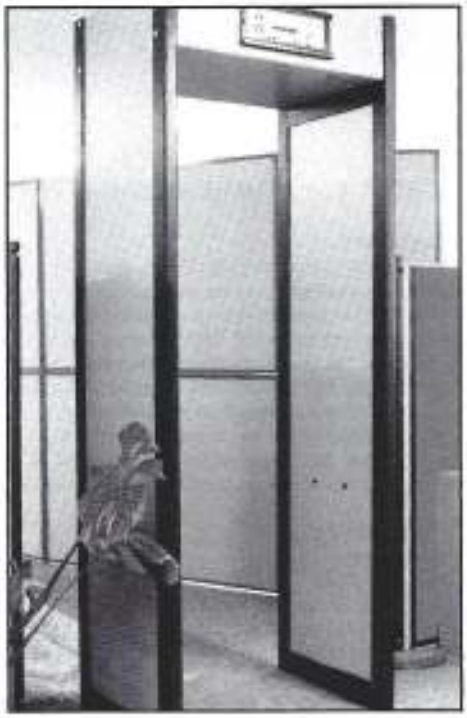
Description
The Passex® 200/210 is a standard metal-detecting archway designed for use in permanent or semi-permanent positions or for where a large number of people are expected, thus reducing the need for hand searching.

The PASSEX® 200/210 is based on differential pulse induction technology, which is designed to give high detection sensitivity and suppress background interference. The detector is insensitive to vibrations and mechanical influence and operates in static mode. If the main power supply is interrupted the device automatically switches to an emergency supply. The built-in batteries have the capacity to last approximately 10 hours.

Specifications
Dimensions
outer: 2,210 × 840 × 595 mm
inner: 2,000 × 750 × 595 mm
electronics box: 110 × 290 × 200 mm
Weight (including electronics): 20 kg (approximate)
Power supply: sealed lead-acid accumulator 12 V/1.3 Ah
Operating time: 10 h (approximate)
Charging time: 14 h (approximate)
Operating frequency: 1 kHz (approximate)
Magnetic field strength: 2,000 nT (approximate)
Radiated electrical field strength: <20 V/m

Status
In production and in service.

Contractor
Ebinger Prüf- und Ortungstechnik GmbH.



PASSEX® 210 archway detector (Ebinger)
0074324

Vallon letter-bomb detector MB 1710A

Description
The MB 1710A provides fast and efficient examination of letters and parcels with this high-sensitivity table unit. The letters to be examined are put on the inclined sensor zone and the detection of a metallic explosive device is indicated by acoustic and visual signals.

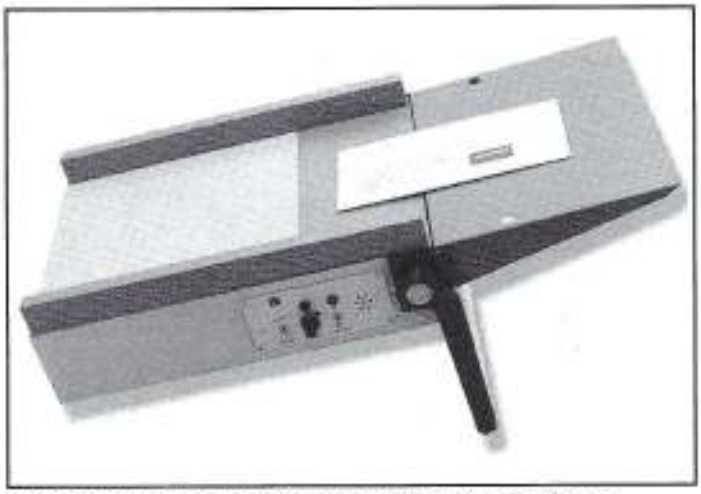
If parcels need to be checked, the 'pin-up guide' beads are removed and the parcel is manually moved over the marked sensor zone. With experience it is possible to examine some hundreds of letters and dozens of parcels within one hour.

An integrated power supply allows operation without mains voltage.

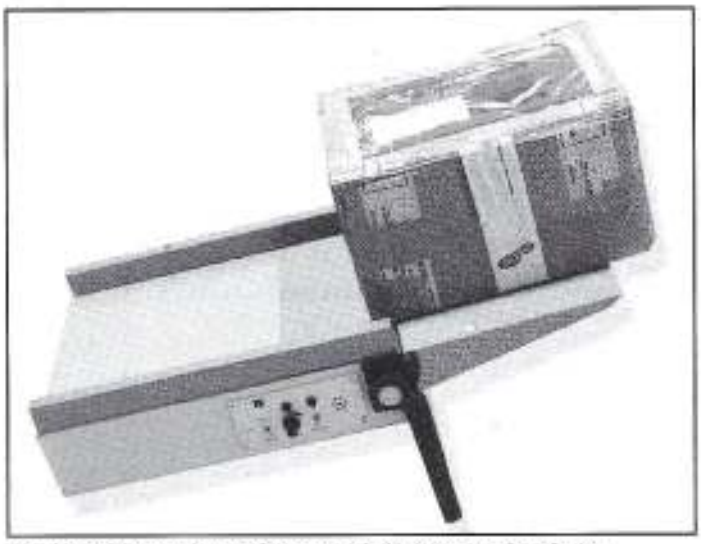
Specifications
Sensor zone: 280 × 250 mm
Power supply: 220 V, 50 Hz
Weight: approx 4.5 kg
NATO stock number: 6665-12-355-2399
Dimensions: 420 × 310 × 140 mm³

Status
In production. In service in many countries worldwide.

Contractor
Vallon GmbH.



The MB 1710A can be used to screen both letters and packages (Vallon)
0573274



The MB 1710A can be used to screen both letters and packages (Vallon)
0573275

Italy

HI-PE Multi-Zone

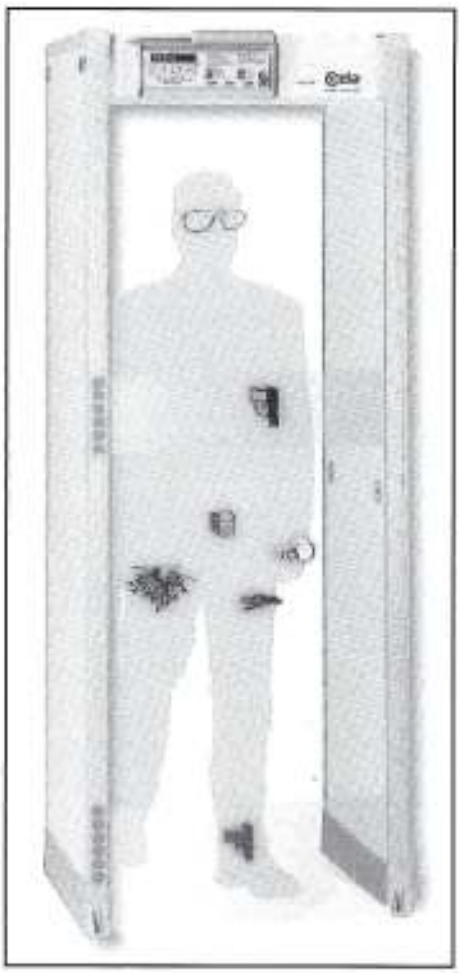
Development
The HI-PE Multi-Zone was designed for use in schools, hotels, public offices, embassies, prisons, courts and security industries.

Description
The HI-PE Multi-Zone is a walk-through metal detector which the company believes exceeds all current International Security Standards. A 'height on person' display indicates, by means of illuminated LEDs, the position of the weapon on the person. The detector's control unit is incorporated into the structure. Accessing to programming is protected both by a mechanical lock and by two alphanumeric passwords. The HI-PE Multi-Zone conforms to ISO 9001 Quality Control Standards. Three operating modes are available.

Specifications
Height:
(total) 2,152 mm
(without electronics unit) 1,965 mm
Width:
(outer) 720, 820 mm
Power supply: 115/230 V AC, +10/–15%, 50 + 60 Hz, 40 VA max
Operating temperature: –20°C to +70°C
Storage temperature: –35°C to +70°C
External interface: RS-232C
Level of protection: IP20 – IEC529
Relative humidity: 0 to 95% (without condensation)

Status
In production.

Contractor
CEIA SpA.



HI-PE Multi-Zone walk-through metal detector
(CEIA SpA)
1298763

United States

Metor 160 archway metal detector

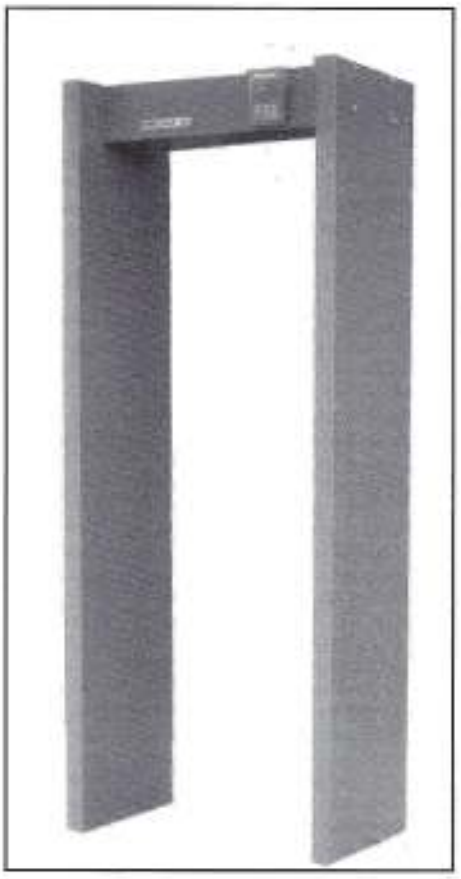
Description
The Metor 160 archway walk through metal detector is an improved version of Rapiscan's AMD-750, having greater discrimination capability for metal objects, capacity for higher traffic flow and improved interference rejection. Features include a choice of 21 detection programmes, six material selection programmes and 100 sensitivity scale settings, self-diagnostic display continuously monitoring operation, easy maintenance and availability of spares. The archway is safe for wearers of heart pacemakers, pregnant women and magnetic recording materials.

The Metor 160 is designed for use at locations where security screening of persons is required, such as airports, banks, prisons, hospitals and exhibition centres.

Specifications
Alarm Indications: red light alarm, light column display for relative object size, adjustable volume and tone for audible alarm
External dimensions
height: 2.176 m
width: 870 mm
depth: 505 mm
Internal dimensions
height: 2.01 m
width: 760 mm
depth: 505 mm
Power supply: 95–250 V AC, 50–60 Hz, 50 V A. Optional internal battery and charger.
Operating temperature: –10 to +55°C
Network connections: MetorNet Remote Security Monitoring System compatible (RS-422 and Ethernet)

Status
In production. In service worldwide.

Contractor
Rapiscan Security Products Limited.



Metor 160 archway detector
(Rapiscan)
0573707

DETECTION EQUIPMENT – VEHICLE MOUNTED DETECTORS

Australia

Minelab STMR array

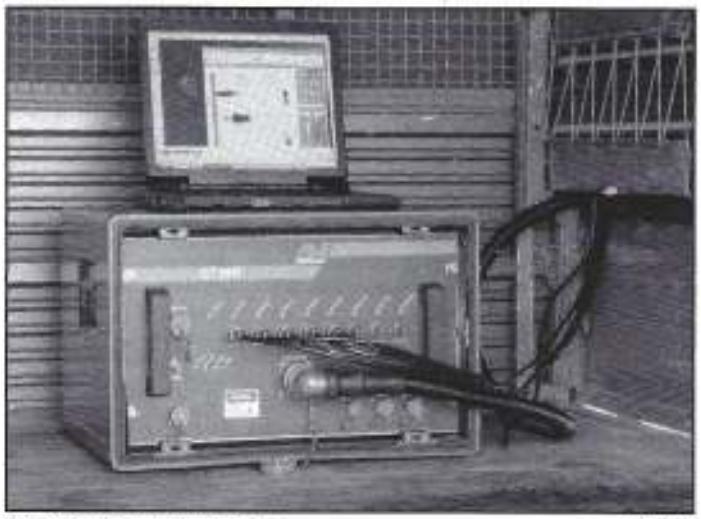
Description
The Single Transmit Multiple Receive (STMR) array is a vehicle-mounted system designed to provide a reliable, effective and efficient means of detecting mines. It uses Minelab's Multi-Period-Sensing and BiPolar technology and is intended for use in route clearance.

The sensing head uses a single transmit coil and dual receive coils. The coils can be located up to 6 m from the control box, which is housed in the vehicle.

Sensitivity of the system is unaffected by vehicle vibration, rain or mineralised ground conditions and is consistent across the width of the array. The system uses Windows® based software for the display of target data to the operator. The STMR can be configured to meet customer requirements.

The array can be deployed as a stand-alone system, or integrated with other detection technologies to include ground penetrating radar and thermal imagery. Ethernet communications permit the rapid transfer of data.

Specifications
Array enclosure
dimensions: 1,820 × 410 × 290 mm to 3,220 × 410 × 290 mm
weight: 17 kg minimum; 32 kg maximum
Weight:
control box: 25 kg (approximate)
coils: 1.26 kg per coil
Data link: 100 MB/s Ethernet to host PC
Positioning: GPS, time and position data stamping
Operating temperature: -30 to +60°C
Operating height: 100–300 mm above the ground
Operating speed: 0–10 km/h
Power: 24 V DC 5 A maximum



STMR control box (Minelab) 1179399

STMR vehicle-mounted mine detection system (Minelab) 1179398

Towed STMR (Minelab) 1179400

Status
In production.

Contractor
Minelab Electronics Pty Limited.

Austria

Schiebel CAMCOPTER® S-100 VTOL UAV System

Description
The CAMCOPTER® S-100 is a highly versatile, fully autonomous vertical take-off and landing (VTOL) tactical unmanned aerial vehicle (UAV) system developed to provide a balance between advanced capabilities and operation in tactical environments. The S-100 made its first flight in the second quarter of 2004.

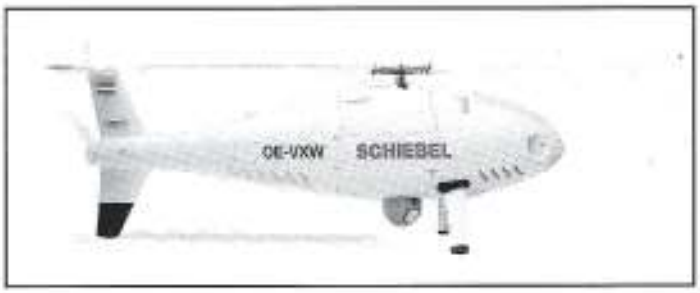
Airframe
The CAMCOPTER® S-100 has a 2-blade main rotor with a streamlined pod and boom fuselage. The latter is a carbon fibre monocoque offering superior strength/weight ratio. It has a dorsal tailfin, with T-tailplane and an underfin. The 3-point landing gear comprises twin single main legs and the reinforced tip of the underfin.

Mission payloads
It has capacity for a wide range of payload/endurance combinations, which can be mounted in or on one of the two payloads bays, an internal auxiliary electronics bay, or fuselage-side hardpoints. The primary payload bay, located directly beneath the main rotor shaft, is capable of mounting payloads weighing up to 50 kg (110 lbs). The side hardpoints are capable of carrying loads up to 10 kg (22 lbs). The secondary bay, located in the nose section, is capable of mounting payloads weighing up to 10 kg (22 lbs). The auxiliary electronics bay is intended for additional instrumentation, such as identification, friend or foe (IFF) or other electronic equipment.

As a standard payload option, Schiebel offers its ESOP™ Electronically Stabilised Observer Payload, which contains a daylight camera, infra-red camera and laser range finder (configurable to user requirements) in an electronically stabilised pan/tilt gimbal mechanism.

Guidance and control
The S-100 can complete its entire mission automatically, from take-off to landing, controlled by a triple-redundant flight computer based on proven flight control methods and algorithms. The operator may take over manually at any point during the flight, as well as add, delete and modify waypoints at any time via an intuitive user interface.

In the manual mode, the operator gives directional commands via a simple joystick; directional commands are then interpreted by the flight control computer in order to provide control surface inputs appropriate to the desired manoeuvre, while assuring that the air vehicle (AV) remains within its performance limitations. In both modes, the AV is automatically stabilised.



Camcopter® S-100 UAV system (Schiebel) 1181681

The control station concept is scaleable, from operation from two laptop computers (one for mission planning/control, one for payload control and imagery exploitation) to larger, integrated suites. The mission planning/control workstation displays AV position and status information in real-time on a user-friendly, aviation-style instrument panel, with integrated checklists and failure procedures. Mission planning and preparation is undertaken using Geographical Information System (GIS) data and the entire mission can be viewed and rehearsed within a 3-D synthatic environment, to which other layers of GIS data, such as threat zones, no-fly zones and other intelligence information may be added for greater situational awareness. The payload control workstation allows the payload operator to control the payload while also having access to mission planning information. Video viewing, capture and recording are also available.

The command system has been designed to allow the control of multiple AVs via either a stand-alone network or through integration into existing tactical networks. The AV electronics, including data links, are designed to be completely modular, allowing for upgrades or the fitting of customer-specific components.

Transportation
The complete system can be deployed in two 4-wheel drive tactical trucks.

Launch and recovery
Conventional helicopter take-off and conventional helicopter landing.

Specifications

Dimensions
Main rotor diameter: 3.4 m
Tail rotor diameter: 0.66 m
Fuselage length: 3.11 m
Fuselage width: 1.24 m
Fuselage height: 1.04 m

Weight
Empty weight: 100 kg
MTO weight: 200 kg
Power plant: 55 hp rotary aviation engine, dual pump-fed fuel injection

Performance
Dash speed: 120 kts
Cruise speed: 55 kts (for best endurance)
Service ceiling: 18,000 ft MSL2
Endurance: 6 h (with 25 kg payload)
Maximum payload: 50 kg

Status
In production.

Contractor
Schiebel Elektronische Geräte GmbH.

Schiebel Vehicular Array Mine Detection System (VAMIDS™)

Development
The Schiebel Vehicular Array Mine Detection System (VAMIDS™) is designed to detect metallic land mines, including those with minimal metal content and unexploded ordnance (UXO), from a vehicle platform.

Description
With the use of special array segments, VAMIDS™ can detect buried UXO to depths of several metres. Although the system is designed for use along established routes and flat ground, it also has a cross-country capability, depending on the terrain and the mobility of the vehicle platform. The system can be used in conjunction with Directional Global Positioning System (DGPS) and includes an optional spray paint mine/UXO marking system.

VAMIDS™ is a modular integrated system comprised of a control unit, a segmented array, and a system console.

The control unit is housed in a watertight and ruggedised case, including an anti-vibration mounted standard military 19 in/483 mm rack. It is suitable for adverse environmental conditions and vehicle applications.

The control unit contains: a power card; up to 12 sensor cards, each interfacing with a group of four detection coils; one processor card for converting and processing the data received from the sensor cards and for transmitting information from the system console via a system data port. The VAMIDS™ main interface is an RS-485/RS-232 selectable system data port. The control unit also provides an RS-232 interface on the processor card face plate for local system access, a synchronous serial data interface capable of indicating the exact location of a target to a marking system and an output switched to the supply voltage under the control of the processor to flag a global event warning. The control unit circuit cards provide face plates with control and display components for maintenance purposes.

The segmented arrays can be either mounted on a vehicle structure or pulled over the ground surface. Individual segments provide overlap areas on either side and may be arrayed up to a maximum width of 6 m. Arrays are designed to be pulled over the ground to provide optimum coverage. The individual detection heads are mounted on a flexible draw-bed structure which serves as a wearsheet, both supporting and protecting the assembled detection heads.

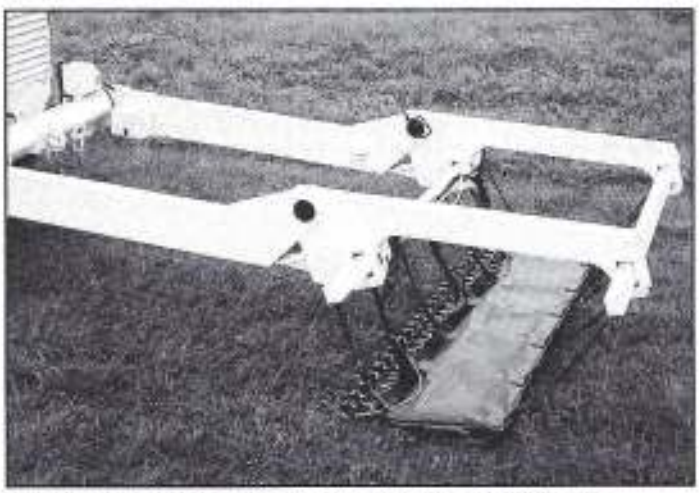
The system console serves as the operator interface and can be an industry standard personal computer. Alternatively, the software functions assigned to the system console may be implemented into a higher level data processing system such as a vehicle control computer. The system console provides a user-friendly, real-time graphical display of up to 48 input detection channels from a 6 m wide segmented array. The system configuration, set up and diagnostics reporting are tasked by the system console.

Specifications

Control unit
Weight: 14 kg (max)
Width: 534 mm
Height: 217 mm
Depth: 450 mm
Voltage: 12–24 V DC
Current consumption: 20 A (max)
Pulse frequency (PRF): 2,000 Hz (max)
Data transfer rate: 19,200 Baud (max)

Flexible Array Segment (1 m)
Weight: 20 kg
Length: 613 mm
Width: 1.168 m
Height: 150 mm

Vehicular Array Mine Detection Systems (VAMIDS™) fitted to a Lion II (Schiebel) 1299258



Close up of Vehicular Array Mine Detection Systems VAMIDS™ (Schiebel) 1299259

Effective width: 1 m
Number of detection coils: 8
Max bend angle: ±14°

System console requirements
Processor: Intel Pentium
Display: standard VGA, 256 colour, 640 × 480 or higher resolution, video display adaptor
Hard disk: 100 MB minimum free
Interfaces: 1 RS-232 or RS-485 serial data port

Memory: 256 MB min
Operating system: Windows 95/98/NT/2000
Operating temperature: –40°C to +55°C
Storage temperature: –55°C to +85°C

Status
In production. In service in Canada, South Africa and the United States.

Contractor
Schiebel Elektronische Geräte GmbH.

Germany

Mine-Cat 4.600

Description
The Föerster Mine-Cat 4.600 is a vehicle-mounted metal detecting system, consisting of a detector array, control unit and target marking device. Employing some of the technology found in Föerster's MINEX 2FD 4.600, the Mine-Cat's metal detector works by continuous wave EMI and its control unit allows data sampling and evaluation, as well as real-time display. Power is normally supplied via the vehicle's own supply at 12 V AC or 24 V DC.

Specifications
Search head (rectangular): (1.2-2.5) × 0.31 × 0.05 m
Working length: 1.2–2.5 m

Weight
search head: 15.0 kg upwards, depending on length
control unit: 8.0 kg
Power supply: 12 V AC or 24 V DC
Operating temperature: –35 to +70°C
Storage temperature: –57 to +70°C

Status
As of January 2009, no longer in production.

Contractor
Institut Dr Föerster GmbH and Co KG.

Multi-Cat

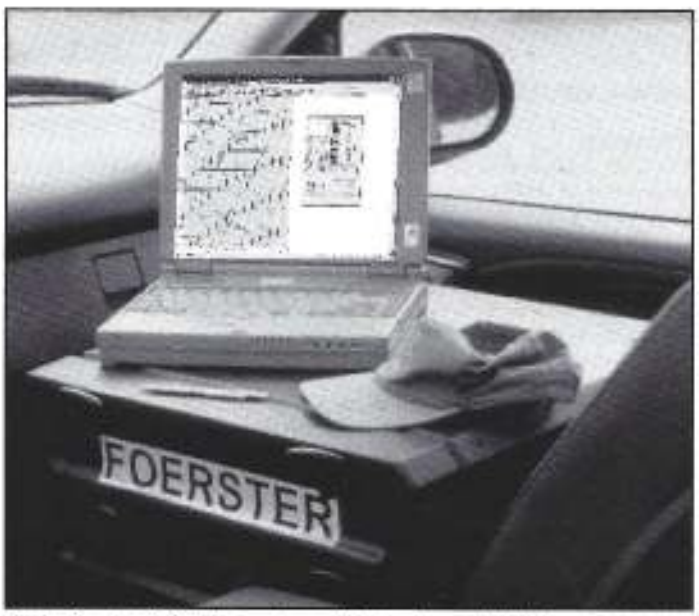
Description
The Föerster Multi-Cat is a towed FEREX gradient magnetometer sensor platform, UXO localisation and mapping system. Built from non-ferrous materials, the Multi-Cat can be used on any terrain accessible by a wheeled towing vehicle. Probe spacing can be 0.25, 0.5 or 1 m, as appropriate for the size and nature of the target. Total search width is 2.0 to 2.5 m and this can be doubled by mechanically joining a second system. Scanning of an area is performed by multichannel datalogging, either on straight parallel tracks, or in any direction when datalogging and mapping are supported by a DGPS system. The search speed is up to 2.5 m/s.

The total weight of the Multi-Cat is approximately 130 kg and its transportation size is 2 × 1 × 1 m. The length of the tow bar can be altered to allow for the magnetic signature of the tow vehicle. An adjustable tow bar link allows correct vertical positioning of the probes.

Status
In production.

Contractor
Institut Dr Föerster GmbH and Co KG.

Föerster Multi-Cat (Föerster) 0056055



Evaluating Multi-Cat data on board the towing vehicle (Föerster) 0074217

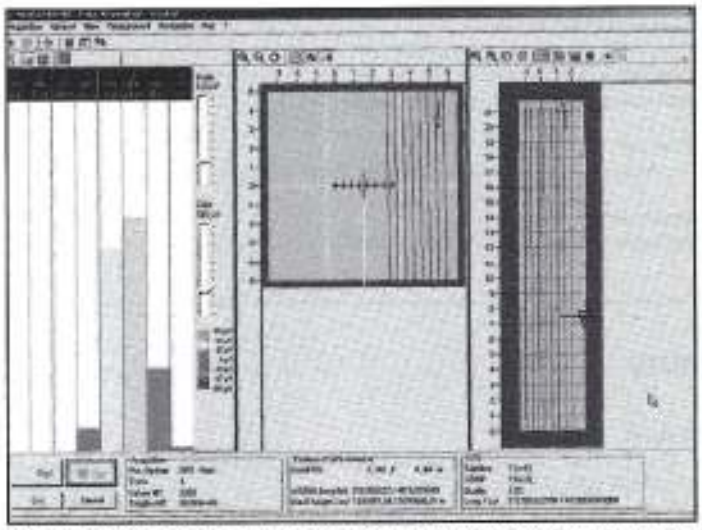
Vallon vehicle-mounted metal detector VMV8

Description
The Vallon vehicle-mounted metal detector VMV8 has been designed for the localisation of metal objects in the ground, such as metal mines, plastic mines with a larger metal content and UXOs. The unit is recommended by the manufacturer for quality assurance operations following manual demining.

The VMV8 uses modern Digital Magnetic Pulse Induction (DMPI) technology and the equipment is based on the electronics of up-to-date hand-held metal detectors.

The search head contains eight overlapping coils, which transfer the measured signals to a computer controlled central electronics unit. This processes the signals from the detector coils along with the position; soil condition is also taken into consideration during the evaluation.

The detector is operated via a ruggedised Mobile Personal Computer (MPC) (see separate entry) running the VMV8 software to control display, operation and documentation. A range of functions, including real-time display as a scrolling colour map and bar graph display of signal strength per coil, can be displayed on the MPC screen.



Real-time colour maps and bar graphs can be displayed on the screen (Vallon) 1041286

The VMV8 search head contains 8 overlapping coils (Vallon) 1041288

An optional 16-colour marking system (2 per channel), with the facility to set an alarm threshold at two different levels, enables the detection position to be marked with two colours.

Specifications
Weight (search head with spoiler): 55 kg
Search head dimensions: 3 × 0.46 m (larger on request)
Distance between search head and vehicle: min. 1.5 m, max 2.08 m
Power supply: external 12–30 V DC car battery

Status
In production. In service in many countries all over the world.

Contractor
Vallon GmbH.

A ruggedised mobile personal computer is used to operate the VMV8 detector (Vallon) 1041287

Vallon vehicle-mounted mine detector VMV4

Description
The Vallon vehicle-mounted mine detector VMV4 has been designed for the localisation of metal objects in the ground, including metal mines, plastic mines with a high metal content and UXO. The unit is recommended by the manufacturer for use in quality assurance, following mine clearance operations.

The VMV4 uses Digital Magnetic Pulse Induction (DMPI) technology and is based on the electronics of modern hand-held metal detectors.

The search head contains four overlapping coils, which transfer the measured signals to an electronics unit that contains all operation and display elements. The detection signal for each channel is displayed in real-time by four light-emitting diode bar graphs. Additionally an audio alarm is available. An alarm threshold can be set in combination with a light signal or a horn. The coils are highly sensitive and are able to detect minimum metal content mines in strongly mineralised soils as well as under power lines.

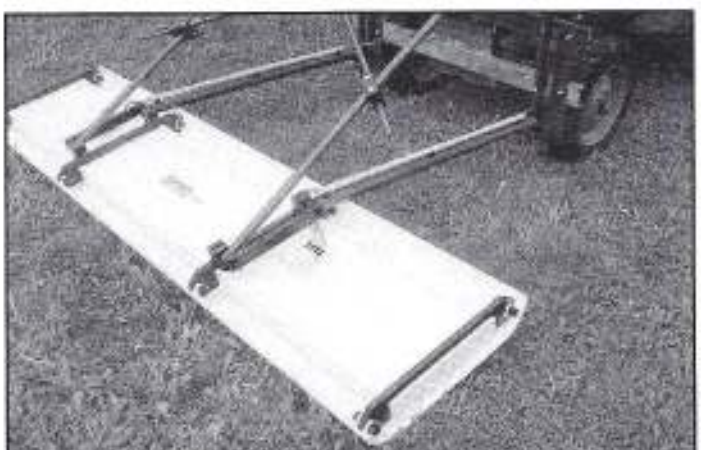
The standard width of the search head is 2 m, but can be changed on request. The search head has a robust, splash-proof and glass-reinforced plastic construction and can be mounted in front of the vehicle, at the side or towed behind.

The protective spoiler is made of Kevlar and glass-reinforced plastic; the mounting device is also metal-free and made of glass-reinforced tubes or as a non-metal trailer version.

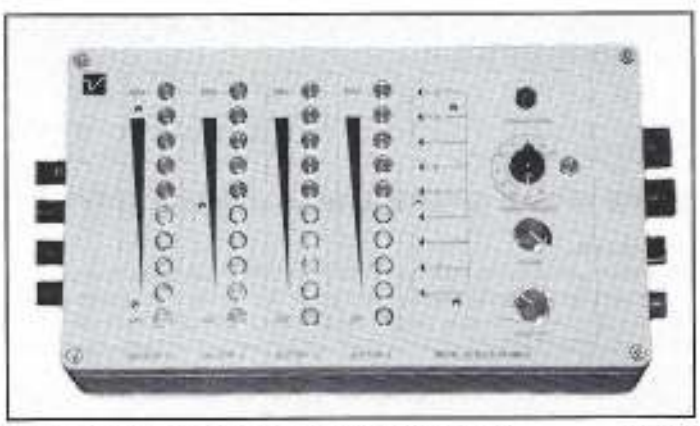
Specifications
Weight (search head with spoiler): 33 kg
Search head dimensions: 2 m × 460 mm (larger on request)
Distance between search head and vehicle: min 1.5 m, max 2.08 m
Power supply: external 10–30 V DC vehicle battery

Status
Production as required. In service with many countries world-wide.

Contractor
Vallon GmbH.



Vallon vehicle-mounted mine detector VMV4 (Vallon GmbH) 0573276



Electronics unit with bar graph display (Vallon GmbH) 0573277

Israel

EL/M-2190 robotic detection system

Description
The EL/M-2190 is primarily designed for military and commercial mine detection applications. It is based on a high-resolution radar that detects, measures, analyses and classifies objects buried in the ground. The radar has a proven capability in a variety of terrains, soils and environments. The system has been designed with modular hardware and software while advanced digital processing and algorithms enable adaptation of the system to various applications. The low-weight radar is mounted on a remotely controlled, low-signature vehicle capable of operating in adverse terrain. The high-survivability system can advance through mine fields while marking, in real time, the detected mines and the vehicle's pathway. Additional sensors such as a high-sensitivity magnetometer, an infra-red camera and a standard television camera can be mounted on the vehicle to achieve enhanced overall system performance.

Specifications
Vehicle velocity: 1 m/s
Detection width: 2–3 m
Detection depth: 0.3 m

Status
In production. In service with Israel, Netherlands, Sweden and Turkey.

Contractor
IAI Elta Electronics Industries Limited.

The EL/M-2190 robotic mine detection system mounted on a remote-control vehicle (IAI Elta Electronics Industries Ltd) 0056059

Remote-control station for the EL/M-2190
(IAI Elta Electronics Industries Ltd) 0056060

Russian Federation

DIM vehicle-mounted detector

Description
The DIM vehicle-mounted mine detector consists of a UAZ-469 series (4 × 4) light vehicle (or other suitable vehicle) modified to carry a frame on which is mounted a non-magnetic sensing head. This is supported by a frame attached to the front bumper. When travelling, the equipment is swung upwards through 180° and rests on top of the cab. When required for use, the equipment is swung forward and rests on two rubber-tyred roadwheels. The sensing head is mounted in front of these wheels and is provided with three pairs of supporting wheels.

The DIM system will detect mines to a maximum depth of 250 mm with a sweep width of 2.2 m. The vehicle is normally driven at a maximum speed of 10 km/h during mine detection operations. Once a mine or metallic object has been detected an audio alarm sounds and the vehicle stops automatically. When the vehicle comes to a halt, the operator can adjust the search coils to pinpoint the exact location of the metal object. No provision is made for remote control of the vehicle.

As the equipment lacks cross-country mobility, it is normally used only for clearing roads and airfields. The system was seen mounted on T-62 MBTs in Afghanistan.

Status
In service with former Warsaw Pact members and some countries in the Middle East.

Contractor
Russian state factories.

DIM mine detector mounted on the front of a UAZ-69 (4 × 4) vehicle
(Christopher F Foss) 0512353

DIM mine detector sensor array 0512354

South Africa

Chubby mobile detection system

Development
Designed in the 1970s for the South African Defence Force.

Description
Primarily designed for mine detection and clearance, the Chubby mobile detection system can sweep up to 35 km of road surface per hour.

The system comprises a Meerkat Mine Detection Vehicle (MDV) and a Husky MDV, which is also used for towing the Duisendpoot Mine-Detonation Trailers. Both vehicles have double mine-resistant V-shaped hulls, and the axle assemblies are designed to be easily repaired by using the Redpack and Blue-pack which are modular component kits which form part of the system. The Redpack contains a set of mobile spare parts which contain front and rear frames complete with steering gear and propshafts, axles, lifting equipment and so on. The Blue-pack contains all secondary parts for example major maintenance parts such as a spare engine and so on. The Red-pack and Blue-pack allows most repairs to be conducted within 1 hour, depending on the damage sustained.

A typical demining configuration train comprises a Meerkat MDV, followed by a Husky MDV, which, in turn, tows two Duisendpoot Mine-Detonation Trailers (MDT). The Meerkat and Husky MDVs are fitted with pulse-induction detector pans which detect anti-tank (AT) mines. Any mines which are bypassed by the detectors are detonated by one of the MDTs, whose varying axle widths give the system a wide detonation track width.

These vehicles can be fitted with mine marking equipment which can be operated from the safety of the MDV's cabin.

Status
In production. In service in South Africa. Also procured by the Australian (3), Canadian, French (5), UK (6) and US armies for operations in Bosnia and other landmine contaminated countries. Uganda purchased two sets in 1996, the operational status of which are uncertain.

Contractor
RSD, DCD-Dorbyl (Pty) Limited.

Dorbyl Chubby Mine Detonation Trailers (MDT), the Duisendpoot (RSD) 0052039

Towing Mine Detection Vehicle (T-MDV), the Husky (RSD) 0100129

Mine Detection Vehicle (MDV), the Meerkat, of the Australian Army (Australian Army) 0096168

Mechem Vehicle-Mounted Detection System (MVMMDS)

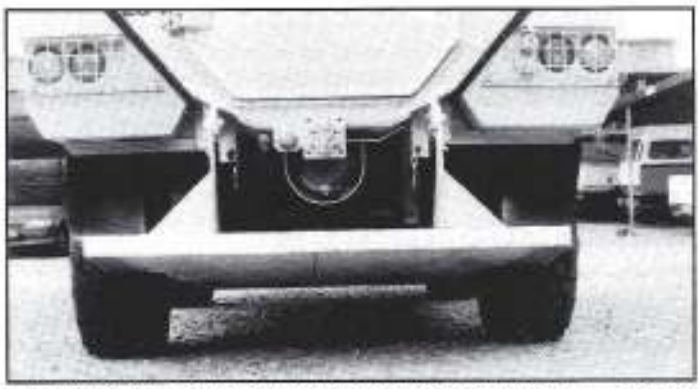
Description
Mechem has devised an electronic pulse induction metal detection system that is mounted on a non-metallic draw-mat coupled to a Mine-Protected Vehicle (MPV). The draw-mat is attached to the MPV by means of a hydraulically controlled swing arm connection that allows the mat to be towed directly behind the vehicle or to either side.

Detection coils are mounted onto the rear of the draw-mat. When a metal object is detected a signal is sent to the control console inside the vehicle where a computer generated image is displayed for the operator to see. At the same instant a pulse is sent to the marking system and the ground is marked (in real time) with white marking fluid over the exact position of the detected metal object.

The non-clogging gel marking fluid is biodegradable and environmentally friendly. It remains visible for at least three days.

The manufacturer claims that the system can detect TM46/47 anti-tank mines up to a depth of 1 m in rocky soil or shale. The operating speed of the system is 5 to 20 km/h. The system is claimed to detect and mark minimum metal mines containing as little as 8 g of metal at depths of 200 mm while travelling at 5 km/h.

A variety of mass, depth, speed and marking combinations can be set. For example, it can be set to only mark signals indicating metal above a specified mass to avoid marking items such as bottle tops, nails and magnetic stones.



Mechem Vehicle-Mounted Mine Detection System (Mechem) 0580713

The MPVs used for the system have a proven track record of protection, being able to withstand the blast from detonating at least a double anti-tank mine underneath any of its wheels.

Status
Available.

Contractor
Mechem, a division of Denel (Pty) Ltd.

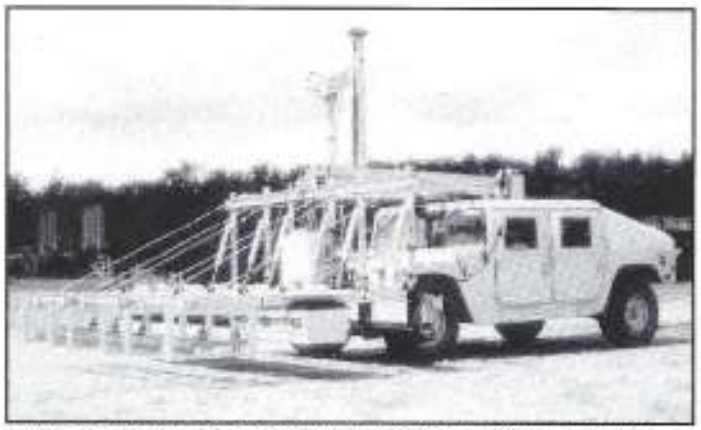
United States

Vehicular Mobile Mine Detector (VMMD) system

Description

The Vehicular Mobile Mine Detector (VMMD) system combines data in real time from three distinct mine detecting sensors: model 301 vertical standoff Energy Focused Ground Penetrating Radar (EFGPR) sensor array unique to Geo-Centers Inc, a Pulsed Induction (PI) sensor and a mast-mounted Forward Looking Infra-Red (FLIR) Camera. All sensors acquire data over a 3 m wide path, at a forward advance rate of 3 to 5 km/h. The data from these devices are combined with information from an onboard Global Positioning System (GPS) to track vehicle and mine location with great accuracy. The data is combined by a powerful image processing computer within the vehicle itself, which applies automatic target recognition and clutter rejection filters to the raw data. The system has been successfully tested in both temperate and arid conditions.

Targets are marked, in real time, on the ground and electronically. The electronic marking system records target locations in latitude/longitude to centimetre accuracy using real-time kinematic, differential GPS. The system can be teleoperated.



Vehicular Mobile Mine Detection (VMMD) System teleoperated at the Socorro, NM test site (Geo-Centers) 0021494

Specifications

Ground Penetrating Radar (EFGPR) sensor
15 in standoff (operating height above ground)
3 m wide swath
Acquires 3-D information with <10 cm spatial resolution
Advance rate of 3 to 5 km/h (potential 15 km/h)

Forward Looking Infra-Red (FLIR) sensor
Acquires 2-D information with <15 cm spatial resolution over 10 m
Provides 10 m standoff
Camera dynamic range (12 bits) allows high-resolution thermal imaging over >30°C temperature range without adjustment
3 to 5 µm bandwidth

Global Positioning System (GPS)
Centimetre accuracy of sensor data location
Sensor synchronisation and Geographical Information System (GIS) intelligence

Status

Continuing development and enhancement.
Undergoing US Army testing.

Contractor

Geo-Centers Inc.

For details of the latest updates to *Jane's Explosive Ordnance Disposal* online and to discover the additional information available exclusively to online subscribers please visit **jeod.janes.com**

DETECTION EQUIPMENT – EXPLOSIVE DETECTORS
Canada

EVD-3000 handheld explosives detector

Description
The handheld explosives trace detectors manufactured by Scintrex are thermo-redox-based systems specifically designed for search applications requiring the immediate detection and location of concealed explosives, including commercial, military and plastic explosives such as RDX and PETN.

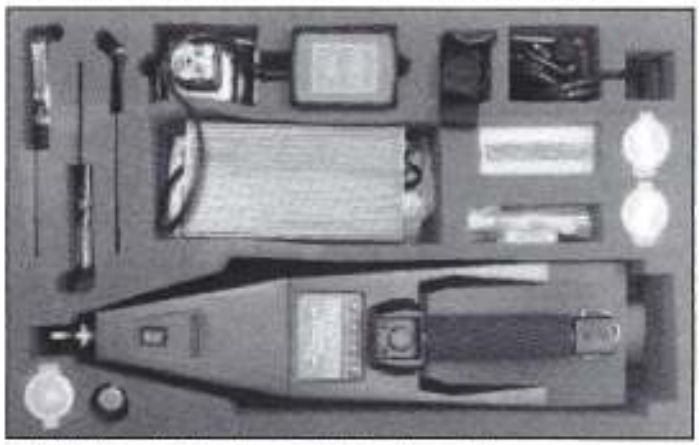
Very portable, the detectors are handheld, lightweight and powered by rechargeable batteries. They require no external gases, have very low consumable cost, require very limited operator training and are easy to maintain and use. The units are capable of detecting both high vapour and low vapour pressure explosives with sensitivities in parts per billion for vapours and better than 10 ng detection levels for particles.

The latest unit, the E3500 explosives trace detector, uses a patented chemi-luminance system that is able to detect both various NO_2-based explosives and peroxide-based explosives like TATP and HMDX.

Specifications
Dimensions: 510 × 140 × 110 mm
Weight: 3 kg or less (depending on type of unit)
Sample time: 5–30 s (user selectable)
Analysis time: 10–16 s (depending on type of unit)
Operating temperature: –5 to +55°C
Storage temperature: –5 to +65°C
Warm up time: 1 min with regular use
Power supply: 12 V rechargeable battery AC/DC power supply or car light adapter

Status
In production and in service.

Contractor
Scintrex Trace Corporation.



EVD-3000 hand-held explosives detector in protective case (Scintrex Trace Corporation) 1299207

EVD-3000 hand-held explosives detector (Scintrex Trace Corporation) 1299208

EVD-8000 explosives detector

Description
Designed as an area monitor but no longer produced by Scintrex, the EVD-8000 is a multicolumn gas chromatograph electron-capture detector. Its high sensitivity and low false alarm rate allow trained security personnel to verify the presence and identity of concealed explosives. The detector is suitable for searching large areas such as airports, aircraft and buildings where high sensitivity and specificity are essential. Both vapour and particle samples are analysed by the detector's microprocessor within one minute, providing information about the quantity and identity of the explosive material detected.

The system has been designed for ease of use – sample injection, analysis and display of results are automatic. Identification of the explosive compounds is presented in both graphical and tabular format via the onboard printer. The detector has low parts per trillion (10^{12}) detection limits for organonitrate explosives and better than 5 ng detection levels for plastic explosive compounds such as RDX and PETN.

The EVD-8000 can be equipped with an optional Portable Supply Module for operation from a 12 V DC source. The module also includes a 4-hour supply of carrier gas.

EVD-8000 area monitor explosives detector (Scintrex) 0074382

Onboard printer presents results in both graphical and tabular format (Scintrex) 0074383

Specifications
Dimensions: 610 x 460 x 200 mm
Weight: 22 kg
Carrier gas: ultra high purity nitrogen gas
Sample time: 15 s (user selectable)
Analysis time: 60 s
Operating temperature: 0 to +45°C
Storage temperature: 0 to +50°C
Warm up time: 45 min with regular use
Power supply: 110/220 V AC, 12 V DC

Status
No longer in production.

Contractor
Scintrex Trace Corporation.

Scintrex Trace Corporation drug and explosives detectors

Description
Scintrex Trace Corporation manufactures the following trace narcotics and explosives detectors:
- EVD-2500 explosives detector;
- EVD-3000 explosives detector;
- E3100 handheld explosives trace detector,
- E3200 handheld explosives trace detector,
- E3500 handheld explosives trace detector;
- N-2000 narcotic trace detector and
- E5000 dual mode (explosive and narcotic) trace detector.

Scintrex Trace Corporation systems detect and identify minute traces of the particles and vapours associated with drugs and explosives. These trace detection systems were designed with the non-technical operator in mind and have simple sampling techniques, one-step analysis and easy to read displays. They were engineered to allow for portability, durability, quick detection and clear, accurate results.

Scintrex also manufactures a Large Vehicle Bomb Detection System (LVBDS) for detecting car explosives. This system is custom-engineered to meet site-specific requirements. The unit is able to interface with already existing security check gates to improve safety.

In 2001 Scintrex Trace Corporation was bought by Autoclear LLC (formerly Control Screening) and the company as a whole also offers x-ray and metal detectors.

Status
In production.

Contractor
Scintrex Trace Corporation.

China

THSCAN™ TR1000 Handheld Explosives Trace Detector

Description
THSCAN™ TR1000 is an explosives trace detector designed and developed by NUCTECH Co Ltd. Based on the principle of ion mobility spectrometry (IMS), the THSCAN™ TR1000 offers a solution to detect trace amounts of explosives and provides effective identification information indicating the presence, the type of explosive materials and the credibility level of the analysis.

THSCAN™ TR1000 finds wide applications in the fields of security screening at sites such as airports, customs, border portals and other crowded public places or other uses as a tool for physical evidence examination.

Status
In production. As of February 2009, more than 210 THSCAN™ Systems have been exported to over 50 countries and regions in Europe, America, Asia, Oceania and Africa, to countries such as Norway, Belgium, Australia, the UK, Bahamas, Thailand, UAE, Australia and Mauritius.

Contractor
NUCTECH.

THSCAN™ TR1000 is an explosives trace detector (NUCTECH) 1298843

Israel

ETK Five explosives testing kit

Description
The ETK Five is an improved version of the original ETK and ETK Plus kits, and has been expanded to detect the improvised explosive TATP.

ETK Five enables simple, rapid and reliable detection of persons engaged in preparing, handling or carrying explosive charges, and allows for fast screening of suspects in the field. The kit aids in detection, through exposure and proof of contact contamination of various surfaces by explosives.

The ETK Five distinguishes between explosive and non-explosive materials and is capable of identifying five classes comprising the majority of explosives currently in use and revealing their traces on the body and various items such as clothes, suitcases, door handles and car surfaces.

The kit is extremely safe for both operator and suspect, as there is no direct contact with the chemical components used in the test. All the test reagents are contained within glass ampoules in specially designed plastic protective tubes. The test is performed by applying a few drops of reagent on absorbing paper. The reagents are guaranteed for one year under normal environmental storage conditions and may be kept for an extended period under refrigeration. After crushing the ampoules, the reliability of the reagent is guaranteed up to two weeks.

ETK Five has been successfully used by Israeli police and security forces and police forces in several other countries.

Status
In widespread service.

ETK Five Explosives Testing Kit 0587889

Contractor
Israel Institute for Biological Research.

Mini-ETK plus Explosives Testing Kit

Description
This is a pocket version of the ETK Plus described in a separate entry. It contains four crushable ampoules filled with liquid reagents for the detection of four groups of explosives: nitro-aromatics (TNT), nitroamines (RDX), organic nitrates (PETN), inorganic nitrates and inorganic chlorates and bromates.

Each kit contains sampling paper, quick reference table and instructions. There is a built-in droplet device in each tube for efficient use. The kit measures 70 × 70 × 25 mm and weighs less than 40 g and its contents can be disposed of immediately after use.

Status
In widespread service.

Contractor
Israel Institute for Biological Research.

Mini-ETK plus Explosives Testing Kit
0516338

Russian Federation

Edelvase-2 explosives vapour detector

Description
Edelvase-2 is an original high-sensitivity gas chromatograph controlled by a microprocessor. It incorporates a unique gas feeding system including a polycapillary gas chromatographic column, removable adsorber-concentrators of original design, sampler devices for taking air samples from objects in any possible situation, a unique probe injector operating automatically according to a prescribed algorithm and providing reliable identification and recognition of the different types of explosive even in the presence of interfering odours. The device has a low false alarm probability and is entirely safe for both operators and inspection personnel.

The principal applications foreseen are the inspection of airline passengers and their baggage, interior compartments of aircraft, vehicles and packages, the inspection of embassies, government establishments or other sensitive assemblies and in research into explosives and toxic substances.

The device will detect nitroglycerine explosives, trotyl, hexogen and plastic explosives (including Semtex). The threshold sensitivity is 3×10^{-15}g/cm³ to the TNT level and 5×10^{-14}g/cm³ to the EGDN level.

Specifications
Sensitivity: 3×10^{-15}g/cm³
Analysis cycle time: 15 s
Sampling distance: up to 100 mm
Weight of hand unit: 1.3 kg

Status
In service in Russia.

Contractor
Institute of Applied Physics.

MO-2 explosive vapour detector

Description
The MO-2 is a man-portable instrument designed for the immediate detection, localisation and identification of hidden explosives as well as residual explosives on exposed surfaces including in field conditions.

Once switched on, the device self-adjusts and is ready for operation within 10 seconds. Automatic adjustment for environmental conditions is provided. Air is continuously drawn into the probe providing effective search capability at a distance of up to 100 mm. Visual and audio alarms can be manually triggered according to an operator-defined threshold. The audio alarm frequency rises as the vapour concentration increases.

The device is simple to use and does not require special operator training.

The complete set comprises detector, battery and charger, voltage converter, accessories and storage case.

Specifications
Explosives detected: TNT, NG EGDN, RDX, octogen, semtex
Sensitivity: 0.01 ppb TNT
Reaction time: within 2 s
Operating temperature: +5 to +45°C
Operating time
DC rechargeable battery at least 3 h
AC 110–220 V, 50–60 Hz at least 23 h
Weight
detector: 1.4 kg
complete set: 5.2 kg
Dimensions
detector: 310 × 100 × 90 mm
packed set: 355 × 280 × 110 mm

Status
In production and offered for export.

Contractor
Institute of Applied Physics.

Pilot-M explosive vapour detector

Development
The Pilot-M is designed to detect explosive scents on or in items such as luggage, vehicles, clothes and documents.

Description
The Pilot-M operates by means of the drift spectrometry method, the data collected by the detection unit being analysed and then displayed on an LCD. The detection unit can operate in a humid environment at a range of temperatures and can also operate effectively in dusty or smoky environments. A heating unit that forms part of the system helps Pilot-M to detect low volatility explosives that have little vapour.

Specifications
Warm-up time: no more than 10 seconds
Analysis time: no more than 1 second
Indication: audio and LCD
Weight (with battery): 2.0 kg
Operating temperature: +5 to +40°C
Dimensions: 300 × 180 × 90 mm
Power supply: AC via 12 V adaptor, DC via 2 rechargeable batteries

Pilot-M explosive vapour detector (STT Group) 1178170

Status
Available.

Contractor
STT Group.

Pilot-M in carrying case (STT Group) 1178178

South Africa

Mechem Explosive and Drug Detection System (MEDDS)

Description

MEDDS is a unique vapour detection system that has been successfully applied to area reduction as part of mine action operations. It combines the remote collection of odour/scent with the acute sense of smell of specially trained dogs, offering a means of detection claimed to be at least as sensitive than other conventional techniques. The system has been in use in Southern Africa for more than a decade and has been employed operationally in many countries such as Afghanistan, Angola, Democratic Republic of Congo, Croatia and Mozambique.

MEDDS is employed in three stages. The first is in the collection of vapours by drawing air through filter tubes by special sampling equipment to capture the volatile vapours of explosives that may be present. This process can either be done by an operator on foot (walking in a safe lane) with back-packed suction equipment, or from a mine-protected vehicle. In the case of the latter, the nozzles for the sampling equipment can either be suspended above ground forward of the front wheels, or to the rear, behind the rear wheels. The filters are changed at set intervals and the filter serial numbers are linked to the GPS reading at the change point.

In the second stage the filter tubes are set up at the analysis facility. This is located in an area that is not contaminated by explosive odours and free from distractions that might interfere with the system. Here, highly trained dogs inspect all the filters and indicate by 'pointing/sitting' at those filters they find to be contaminated by explosive odour. The dogs are usually worked in pairs in order to confirm a positive indication. If there is any doubt, a second pair of dogs can be used to confirm the

A MEDDS Back Pack portable sampling machine (Mechem) 0587892

A Casspir mine-protected vehicle showing the sniffer sampling heads used with the initial stage of MEDDS hanging over the front of the vehicle; the device at the rear of the vehicle is a remotely controlled mineclearing tool and is not part of MEDDS 0512357

A MEDDS-trained dog searches for positive samples 0567424

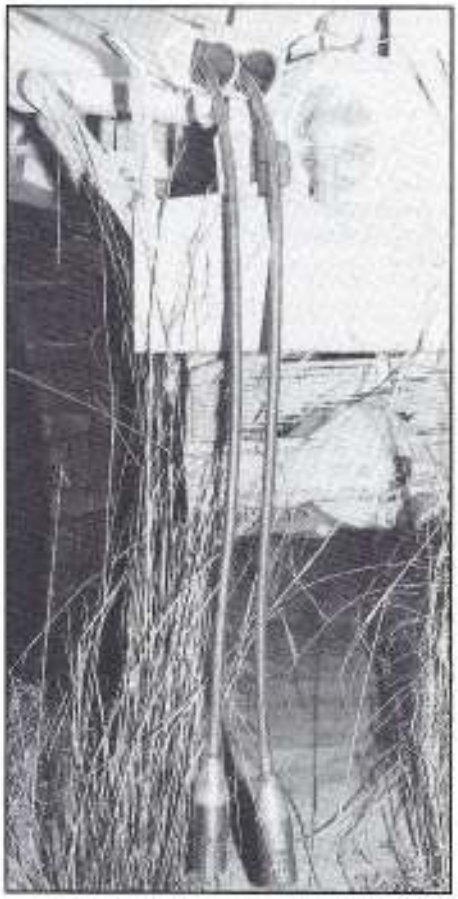
analysis. If there are no indications, the area from which the samples were obtained can be viewed as being clear.

Stage three is the physical demining of the areas identified as containing positive explosive traces using the GPS data recorded during stage one. The search may be undertaken by deminers, or mine detection dogs. By eliminating the 'clear' areas, great savings in costs and resources can be achieved, making MEDDS a useful area-reduction tool.

MEDDS can also be employed to detect drugs and other contraband substances.

Status
Available.

Supplier
Mechem, a division of Denel (Pty) Limited.



Close-up of a pair of MEDDS sniffer sampling heads. They are drawn through the tubes (top) when changing the sampling tubes 0512358

United Kingdom

Searcher explosive and drug detector

Description
Using gamma backscatter technology, this equipment is capable of detecting all types of explosives and drugs of organic composition. The probe assembly houses a cobalt 57 source which radiates gamma rays. These interact with the substance being surveyed and the reaction is read by the electronics unit. Organic material can be detected to an optimum depth of 10 cm through metal skins such as car panelling, brick or masonry walls and other partitioning.

The equipment must be handled by trained personnel since it houses a radioactive source. This source is fully protected in lead casing, emitting the rays only when physically opened using the safety switch.

The Searcher is ideal for search operations in buildings and for vehicles since it can save considerable time accessing difficult areas such as wall, floor and ceiling cavities and vehicle panelling. An extension arm can assist in searching above head height. Probe covers reduce the likelihood of surface damage or scratching.

Specifications
Weight
probe unit: 1.025 kg
electronics unit: 1.075 kg
extension arm assembly: 1.05 kg
equipment case (empty): 4 kg
Power supply: 2 × 9 V alkaline batteries

Status
In production and in service.

Searcher explosive and drug detector (SDS Group Ltd) 0074326

Contractor
SDS Group Ltd.

United States

AMD-14

Description
The AMD-14 is a landmine detector designed specifically for humanitarian demining. It is an inexpensive derivative of the AN/PSS-14 (see separate entry), also produced by L-3 CyTerra. It employs a streamlined set of features designed for the humanitarian deminer, including a sensor that combines ground penetrating radar and metal detection. This sensor is particularly effective in areas of high clutter such as war torn regions littered with metal fragments where discrimination of mines from background is so important.

Status
Available.

Contractor
L-3 CyTerra.

CCX 1335 hand-held explosive vapour detector

Description
The CCX 1335 is a hand-held explosive vapour detector capable of detecting trace amounts of explosives. It is used to screen people, luggage, cargo, vehicles and buildings.

The vacuum opening of the system must be close to the object it is testing. The nozzle is opened and moved across the object. The unit then draws any vapours into its hermetically sealed chamber and, if explosive vapours are detected, the unit alerts the user with both audible and visual signals.

The CCX 1335 can detect known explosives such as ammonium nitrate, dynamite, Semtex, C4, HMX, PETN, RDX and TNT. The distinctive feature of the CCX 1335 is its ability to pass received data to an auxiliary PC through its built-in RS-232 COM connector.

The CCX 1335's total weight, with battery, is 2.0 kg. It has an easy to read LCD display and detects in real time.

Status
Available.

Contractor
Homeland Security Strategies Inc.

Entryscan³ walk-through explosives vapour detector

Description
GE Ion Track's Entryscan³ walk-through vapour and particle detection portal is designed to rapidly examine individuals for concealed explosives in a non-intrusive manner, complementing existing checkpoint security. The Entryscan³ uses the same Ion Trap Mobility Spectrometer (ITMS) technology as the Itemiser and VaporTracer (see separate entries).

The system automatically signals each person, by means of a programmable visual indicator, to enter the portal. Once in the portal, vapours and particles from the person are collected from the natural flow of air generated by the individual's body heat. This collected air sample is rapidly analysed for the presence of explosives or narcotics.

The collector mechanism consists of a highly efficient, single-stage pre-concentrator that traps vapour and particles from the sample and then releases them into the detection system, where they are selectively analysed by the ITMS detector. On completion of the detection cycle, the Entryscan³ signals the person to exit. Simplified controls and indicators enable easy operation and monitoring of the system, while self-diagnostic functions assist routine maintenance. The onboard computer provides complete data logging capability and is able to be networked for remote display and data acquisition.

Specifications
Sensitivity: nanogram levels for explosives and narcotics
Explosives identified: C4, Nitroglycerin, PETN, RDX, Semtex and TNT; new substances can be added to the detection catalogue
Analysis time: adjustable as required. Normal processing rate is 10 s per person
Calibration: continuous automatic internal calibration, one-step manual verification
Entrance width: 760 mm
Width: 1.62 m
Depth: 1.02 m
Height: 2.59 m
Power supply: 208/230 V AC 50/60 Hz

Status
In production and in service.

Contractor
GE Ion Track (formerly Ion Track Instruments).

EXFINDER 152 hand-held explosives vapour detector

Description
The Exfinder 152 is an improved version of the Model 150 featuring greater immunity to false alarms and better performance in humid environments.

The detector uses ion drift technology to measure the electronegative property exhibited by nitro-explosive vapours. An electrically charged plasma is generated by negative corona discharge from a very fine pinpoint. Explosive ions are formed in the plasma close to the pin and carried in an airflow down the chamber. A collector electrode is arranged in the wall at a distance down the tube so that only the heaviest explosive ions are collected and measured in the signal processing circuit. An increase in the ion current collected at the collector is indicative of the presence of explosives in the sampled air. The current signal is processed to provide an audible and visual output whose frequency is proportional to the detected current.

Specifications
Sensitivity: concentrations greater than 1 part dinitrotoleune explosive vapour in 10^9 parts of air
Response: 1 s or less
Dimensions (hand unit): 420 × 50 × 50 mm
Weight: 880 g
Power supply: 12 V rechargeable battery for 14 h continuous use

Status
No longer in production.

Contractor
GE Ion Track (formerly Ion Track Instruments).

Exfinder 152 system as supplied (Ion Track Instruments) 0074391

Exfinder 152 hand-held explosive vapour detector (Ion Track Instruments) 0074390

Ionscan 400B trace explosives and drugs detector

Description
The Ionscan 400B uses Ion Mobility Spectrometry (IMS) technology to detect and identify trace amounts of more than 40 explosive and narcotic substances in an 8 second analysis. A sample is collected by wiping a swab over the item to be tested, and the sample is then placed in the detector for analysis. A colour-coded display presents the results to the operator: if a contraband substance is detected, the specific explosive or narcotic name is identified on the display.

A simple wipe with a swab over items such as checked or carry-on luggage, portable electronic devices, and packages is all that is necessary to collect a sample which is then placed into the IONSCAN for analysis. If a contraband substance is detected, the specific name is identified on the display. A detection of trace explosives indicates that an explosives device may be present or that the person may have been handling explosive material in preparing a bomb and further investigation is necessary.

Additional options include worldwide remote monitoring and interactive CD-ROM training.

Specifications
Explosives detection: RDX, PETN, TNT, Semtex, Tetryl, nitrates, NG, HMX and others detected to pg levels
Size: 400 × 340 × 320 mm
Weight: 22 kg
Analysis time: 6–8 s
Sample collection: swab sampler
Calibration: self-calibrating

Status
In service; the Ionscan 400B is now available from Smiths Detection.

Contractor
Smiths Detection.

Ionscan 400B (Smiths Detection) 0074381

Ionscan 500DT explosives and drugs detectors

Description
Ionscan 500DT is a desktop trace detection system capable of simultaneously detecting microscopic amounts of 40 types of explosive substances and more than 40 types of narcotic.

It utilises Ion Mobility Spectrometry (IMS) detectors to identify sub-nanogram amounts of explosive and narcotic substances in less than 8 seconds from a single sample. It incorporates two independently controlled IMS detectors in a single system, one optimised for explosives and the other for drugs.

Specifications
Technology: Dual Ion Mobility Spectrometry (IMS) Technology
Weight: 95 kg
Size:
with screen down 40 × 31 × 40 cm (16 × 12.5 × 16 in)
with screen up 40 × 57 × 40 cm (16 × 22.5 × 16 in)
Sample collection: an advanced sampling wand eliminates the need for the operator to handle the swab after every sample
Operational ranges: 0 to +40°C
humidity ranging from 0–5% non-condensing.
Power: mains adaptor
Controller: touch screen, colour display with built in printer. Operated by simple to use software with colour coded interface
External data storage: internal data storage

Status
Available.

Ionscan 500DT (Smiths Detection) 0585740

Contractor
Smiths Detection.

ITEMISER³ narcotics and explosives detection and identification system

Description
GE Ion Track's ITEMISER³ desktop contraband detection and identification system is designed to simultaneously detect traces of both explosives and narcotics on almost any surface in under ten seconds. The system uses Ion Track Mobility Spectrometry (ITMS) that has been enhanced by adding high-speed switching technology that allows identification of time-of-flight peaks for substances in both positive and negative ion modes.

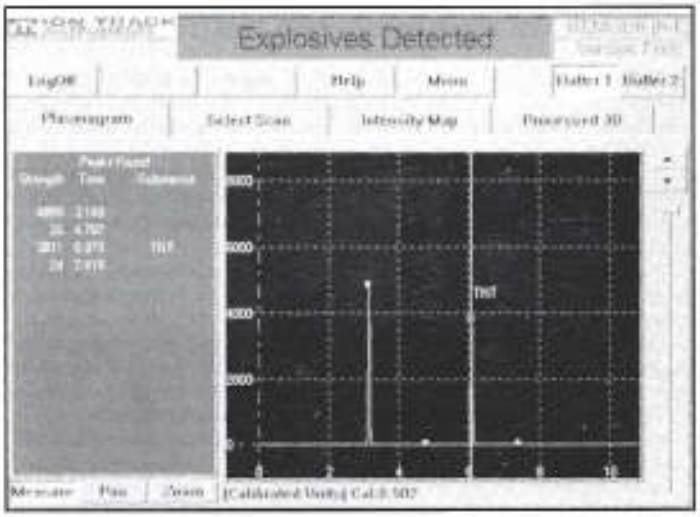
ITEMISER³ is fully automatic: an operator samples the surface of an item that is suspected of being contaminated and inserts the 'sample trap' in the slot located in the front of the instrument to trigger analysis.

ITEMISER® contraband detector (Ion Track Instruments) 0074385

Specifications
Sensitivity: picogram levels for explosives and narcotics
Explosives identified: Ammonium Nitrate, C4, Dynamite, HMX, PETN, RDX, Semtex, TATP, TNT, and others.
Analysis time: 4–10 s per sample
Calibration: continuous automatic internal calibration, one-step manual verification.
Width: 482.6 mm
Depth: 457.2 mm
Height: 177.8 mm (381 mm with touch-screen display open)
Power supply: 115/230 V AC 50/60 Hz; DC input jack 11–16 V DC, 10 A max

Status
In production and in service.

Contractor
GE Ion Track (formerly Ion Track Instruments).



Plasmagram explosives alarm screen (Ion Track Instruments)
0074386

Model 97HS portable explosives vapour detector

Description
The Model 97HS portable explosive vapour detector uses twin gas chromatography with electron capture detection technology. Its response to explosive vapours is typically 2 seconds and when used with the optional Vapour Intensifier is capable of detecting pure plastic explosives.

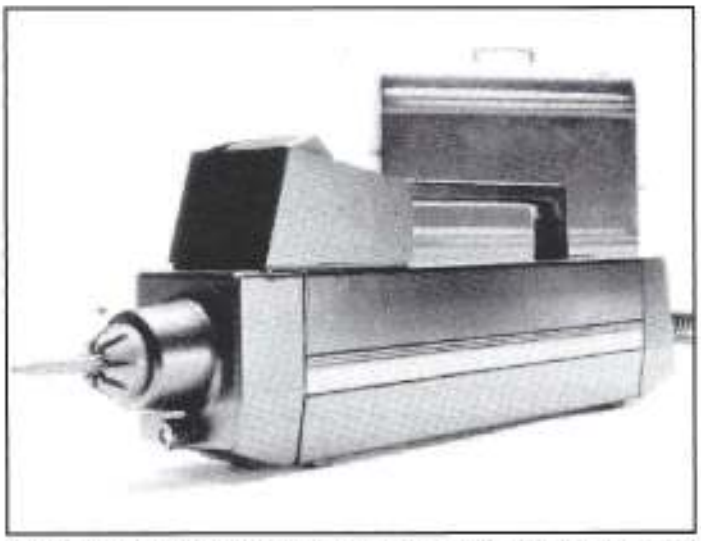
The detector is simple to operate; no special training is required. The flexibility and portability of the detector makes it suitable for rapid screening in a broad range of threat scenarios.

Model 97HS is supplied complete with spare battery, charger and test samples in two cases for convenient transport and use.

Specifications
Sensitivity: 1 part dinitrotoluene explosive vapour in 10^{11} parts of air by volume
Response: typically 2 s
Dimensions (hand unit): 400 × 70 × 160 mm
Weight: 1.75 kg
Power supply: battery

Status
No longer in production. In service with NATO forces worldwide.

Contractor
GE Ion Track (formerly Ion Track Instruments).



Model 97HS portable explosives vapour detector (Ion Track Instruments)
0074392

Sabre 4000 hand-held detector

Description
Sabre 4000 is a hand-held, battery-operated dual-mode instrument which can detect and identify volatile agents as well as narcotics, toxic industrial chemicals and chemical warfare agents. It can be used to screen suspicious items received or abandoned in public places and to conduct routine checks on vehicles or people, at entrances to facilities or during times of high security alert.

It features a 9 cm (3.6 in) colour TFT display, capable of rendering results as plasmagrams and can store 300 measurement results. The battery offers 8 hours running time on a fully charged battery.

Sabre 4000 uses the proven Ion Mobility Spectrometry (IMS) technology used in other Smiths Detection security products (see separate entries). It can be connected to a PC for data viewing and programming using Instrument Manager (IM32 software). Although designed for portable use, an optional desktop cradle is available for fixed site use.

Specifications
Explosives detected: RDX, PETN, TNT, Semtex, NG, ammonium nitrate and others
Size: 330 × 115 × 130 mm
Weight (with battery): <2.6 kg
Analysis time: 15 to 20 s
Warm up time (maximum): <10 min
Power supply: 12 V DC, 110/220 V AC, 4 h battery

Sabre 4000 (Smiths Detection) 1113322

Status
Available.

Contractor
Smiths Detection.

VaporTracer² portable contraband detector

Description
VaporTracer² portable contraband detector is Ion Track Instruments' latest technology available for detecting explosives and narcotics. Based on their patented Ion Trap Mobility Spectrometer (ITMS), the VaporTracer² is designed to be used in demanding security environments where fast and accurate analysis is essential. Significant improvements to the VaporTracer² have enhanced the detector's capabilities. Key to the VaporTracer² development is a pre-concentrator nozzle that fits on the

end of the detector to improve vapour detection and allow for enhanced trace particle detection.

The VaporTracer² adapts to different detection scenarios. Each application, as well as every contraband substance, has an optimum collection procedure. PETN, for example, is best detected by means of particle sampling (wiping a surface to collect particles of a substance). Dynamite and nitroglycerine have a better chance of being detected by sampling the vapour emitting from the cracks or small openings of a container or vehicle in which they are packed.

Specifications

Sensitivity: picogram levels of sampled material for explosives and narcotics (as tested by US government agencies)
Explosives identified: Ammonium nitrate, C4, Dynamite, HMX, PETN, RDX, Semtex, TATP, TNT
Analysis time: real time
Calibration: automatic
Width: 127 mm
Depth: 406.4 m
Height: 228.6 mm
Weight: 3.2 kg
Power supply: 115/230 V AC 50/60 Hz mains; 12 V DC; optional 1.5 h battery, 6 h battery pack

Status

In production and in service.

Contractor

GE Ion Track (formerly Ion Track Instruments).

VaporTracer™ portable contraband detector (Ion Track Instruments) 0074388

Viper portable plastic explosive detection system

Description

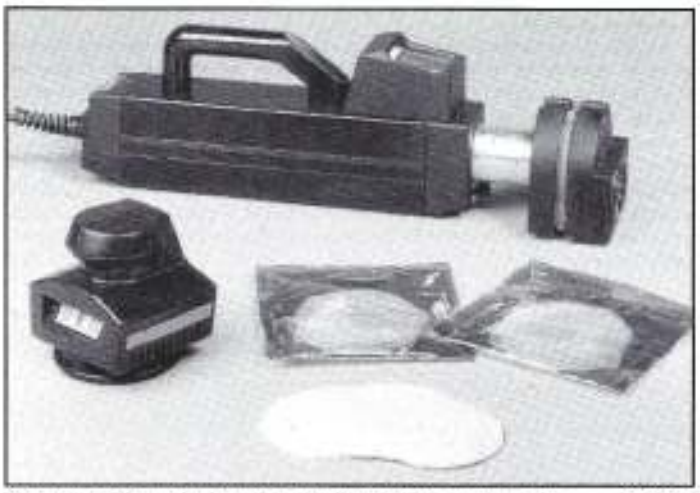
The Viper is a low-cost, real-time portable explosives detector capable of detecting both vapour and particulates of pure plastic explosives such as Semtex, RDX and PETN as well as other types including TNT and Dynamite.

Viper is intended for searching and screening people, packages, hand baggage, hold luggage, vehicles and electronic products, and to investigate suspicious items. After sampling, any response to explosives is displayed within 3 seconds, and the system quickly resets automatically to allow fast security checking to maximise throughput.

A hand-vacuum unit collects samples on a trap paper, either as the vapour, or as particles directly wiped from suspect surfaces. Once collected the sample is placed in the intensifier and vaporised before passing into a twin gas chromatography system for high-sensitivity electron capture detection.

Specifications

Sensitivity: 1 part Dinitrotoluene explosive vapour in 10^{11} parts air by volume
Instrument case
dimensions: 500 × 370 × 160 mm
weight: 13 kg
Support case
dimensions: 500 × 370 × 160 mm
weight: 10.5 kg
Hand unit
dimensions: 400 × 70 × 160 mm
weight: 1.75 kg
Power supply: battery



Viper portable explosives detector (Ion Track Instruments) 0074387

Status

No longer in production.

Contractor

GE Ion Track (formerly Ion Track Instruments).

XD-2 *i*

Development

The XD-2 *i* is a portable Explosives Trace Detector (ETD) which was originally designed for first responders. It can detect over 40 different types of commercial, military and home-made explosives including: liquid explosives, black powder, nitrocellulose, smokeless gun powders, ANFO (Ammonium Nitrate Fuel Oil), nitrates, nitro-aromatics, plastic explosives, peroxides, chlorates, explosive taggants, as well as many other wet or dry threat explosives.

Description

The XD-2 *i* requires no warm-up time, no calibrating, no downtime between samples, and has no carry over after explosives are detected. It supports swab and swipe sampling and is suited to screen air cargo, broken cargo, carry-on luggage, hold luggage, mail, personnel, packages, vehicles and so on.

Components of the kit include: XD-2i Unit, 300 swipes, 3 solutions, solution integrity test kit, 110 V power cord, 12 V DC cigarette lighter adapter and 8 AA batteries (all contained in a waterproof carrying case).

The XD-2 *i* is claimed by the manufacturer to be easy to use as users with no checkpoint screening experience or explosive detection training

XD-2 i Explosives Trace Detector (American Innovations Inc) 1334708

can easily operate it. Successful testing of the XD-2 *i* has been carried out under environmental conditions such as high humidity, extreme temperatures, elevated altitudes and outdoor use including desert-like terrain. Detection time of the XD-2 *i* varies and is dependant on the type of explosives detected. The Department of Homeland Security Transportation Security Lab has evaluated the XD-2 *i* and the DHS Test Report (DHS/STD/TSL-08/02) is available to recognised government agencies, upon request. Field testing of the XD-2 *i* has also been conducted.

Status
In production.

Contractor
American Innovations Inc.

XD-3 *i*

Development
The XD-3 *i* is an Explosives Trace Detector (ETD) which was designed for check point screening. It can detect over 40 different types of commercial, military and home-made explosives including: liquid explosives, black powder, nitrocellulose, smokeless gun powders, ANFO (Ammonium Nitrate Fuel Oil), nitrates, nitro-aromatics, plastic explosives, peroxides, chlorates, explosive taggants, as well as many other wet or dry threat explosives.

Description
The XD-3 *i* requires minimal warm-up time, no downtime after explosives detection, and has a low false alarm rate. It supports swipe sampling and is suited to screen air cargo, broken cargo, carry-on luggage, hold luggage, mail, personnel, packages, vehicles and so on.

A quick swipe of any surface which is suspected of being exposed to trace levels of explosives, followed by the insertion of the swipe into the XD-3 *i* and the system is ready to analyse. Analytical explosives detection chemistry and a computer are the foundation of the XD-3 *i*. Visual and audible detection alerts indicate the presence of a threat explosive or explosive material.

The XD-3 *i* can detect trace levels of explosives or verify bulk explosives without downtime between samples or after explosives are detected. The system can operate in a variety of environmental conditions including elevated altitudes and +120 degree temperatures. The XD-3 *i* is claimed by the manufacture to be user friendly as users with no checkpoint screening experience or explosive detection training can operate the system. The XD-3 *i* Kit is comprised of the following: XD-3 *i* unit, 600 swipes, splash guards, priming pads, 4 reagent solutions, 110 V power cord, AC to DC adapter, 16 AA batteries and PC wireless mouse (contained in waterproof carrying case).

XD-3 i Explosives Trace Detector (American Innovations Inc) 1334708

Status
In production.

Contractor
American Innovations Inc.

DETECTION EQUIPMENT – OTHER DETECTORS

Germany

Ebinger EBEX® 420 DR wire locator

Description
The EBEX® 420 DR is a passive wire locator for use in EOD and improvised explosive device disposal. The locator detects high frequency signals emitted around wires and miniature transmitters. It is designed to find hidden or buried wires used as firing cables or communication lines.

The locator consists of a watertight halo search head and hinged handle containing the locator electronics, battery compartment and sensitivity adjuster.

In use adjustment of the locator is limited to calibration of the audio threshold that determines the locator's sensitivity. The low weight and compact design make the locator easy and comfortable to use. An optional extension rod can be supplied as an accessory.

The locator detects ambient fields of high frequency which build up around wires acting as antennas. This antenna effect differs from the influences resulting from metal mesh in fences or reinforcements in concrete. In an area or rooms with weak ambient high frequency signals a hand-held transmitter can be used to improve detection results.

Specifications
Halo head diameter: 200 mm (approximate)
Electronics unit: 35 mm diameter x 350 mm long
Length: 640 mm
Length with extension rod: 1,160 mm
Weight
short version: 0.9 kg
long version: 1.2 kg
Operation time
alkaline battery: 12 h (approximate)
rechargeable battery: 3 h (approximate)
Operation temperature: –20 to +55°C
Power supply: 9 V E-block dry battery or corresponding rechargeable battery

Status
In production and in service.

Contractor
Ebinger Prüf- und Ortungstechnik GmbH.

EBEX® 420 DR wire locator (Ebinger) 1041248

Russian Federation

Anker-4E explosive timers detector

Description
The Anker-4E is designed for the contact-free detection of timers and remote-controlled explosive devices. The instrument detects mechanical (clockwork based), electromechanical and electronic (including wrist watch based) timers, as well as electronic remote-controlled explosive devices using decoders such as pagers and cellular telephones.

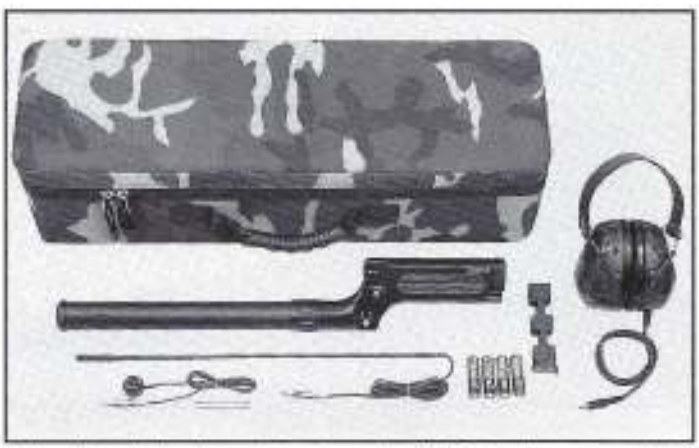
The operating principal of the detector is based on the reception of electrical, magnetic, acoustic and vibration fields, which are created by electronic and mechanical timers and control circuits of explosive devices, and the subsequent analysis of periodic rhythms present in adopted signals.

The detector is simple to use, lightweight and compact.

Specifications
Detection range
electromechanical clock based fuses: 150–400 mm
electromechanical wrist watch based fuses: 150–400 mm
electronic remote-controlled devices: 30–100 mm
Power supply: 4 x AA batteries
Battery life: >40 h
Weight: 0.6 kg

Status
In production and in service.

Contractor
STT Group.



Anker-4E explosive timers detector system (STT Group) 1178164

Anker-4E explosive timers detector (STT Group) 0573709

Anker-P explosive timer and controller detector

Description

The Anker-P is designed for the contact-free detection of time moderators and electronic devices with command decoders. The instrument detects mechanical (clockwork based), electromechanical and electronic timers and electronic remote-controlled explosive devices, as well as multiple, small metal objects. Power is supplied by 9 V batteries.

Specifications

Detection range (approximate)
mechanical and electromechanical timers (alarm clock type): up to 5.0 m
electronic timers: up to 1.20 m
electronic remote-controlled devices: up to 1.5 m
multiple, small metal objects up to 5 m

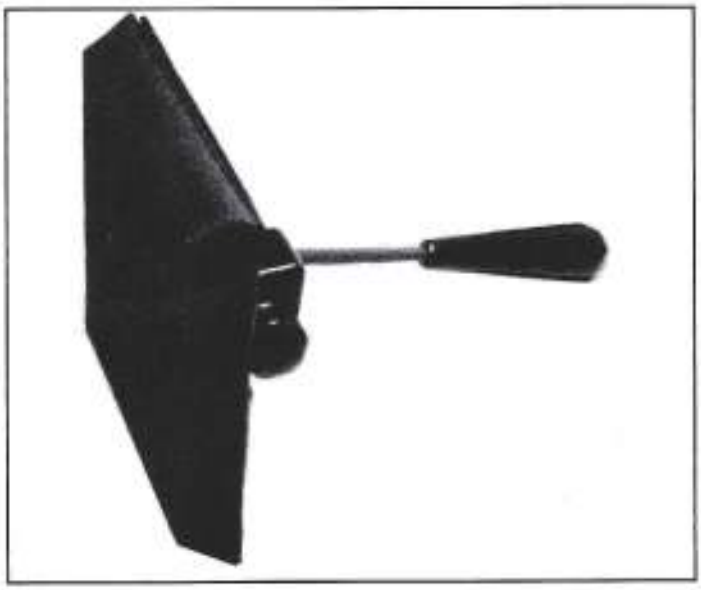
Power supply: 9 V batteries
Dimensions
length: 195 mm
width: 195 mm
thickness: 20 mm
Operating temperature: +5 to +40°C
Weight: no more than 0.8 kg

Status

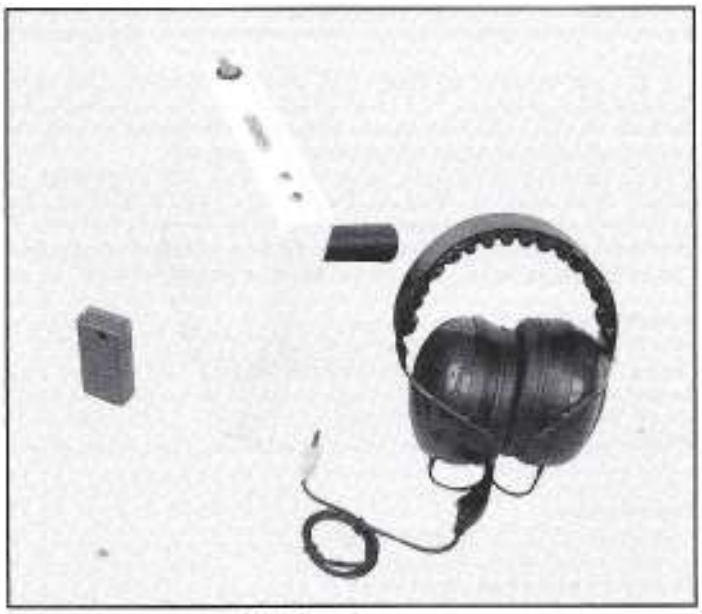
In production and in service.

Contractor

STT Group.



Anker-P detector unit and handle (STT Group) 1041289



Anker-P detector system (STT Group) 1178158

Non-linear detector

Description

The non-linear detector is a portable device designed for the remote detection of mines with non-contact electronic fuzes or other munitions containing electronic circuitry. The detector can be used for the remote search of objects located on the ground surface, in the ground or under snow.

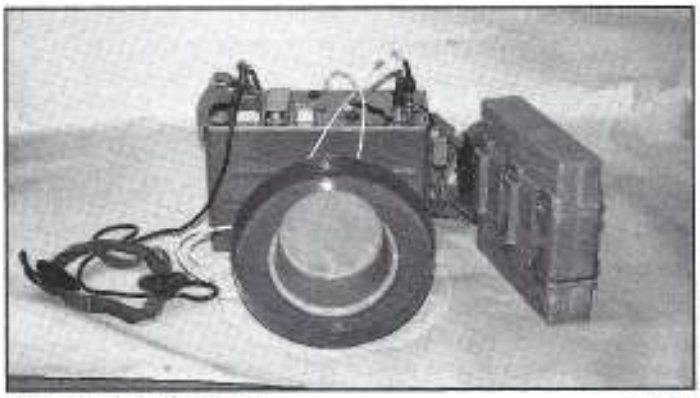
The detector can be transported by one operator and has a detection range of up to 20 m. Power is supplied from batteries installed in a power unit. Remote power supplied from a vehicle at a distance of up to 20 m can also be used. The set is delivered with a packing case and boxed set of spare accessories.

Specifications

Detection range: 20 m
Voltage: 12 or 24 V
Operating temperature range: –50 to +50°C

Status

Believed to be in production.



Non-linear detector (Tomsk) 0021484

Contractor

Tomsk Measuring Apparatus Factory.

NR-μ non-linear junction detector

Description

The NR-μ is designed to detect covert electronic devices containing semi-conducting components. The device allows the inspection of light constructional elements of buildings including furniture, and the detection of covert surveillance devices, such as radio microphones and microphone amplifiers, in different operational modes.

A lightweight body and built-in cable system between the antenna and transceiver make the device compact and easy to use. The advanced technology within the detector combines the advantages of both pulse and continuous wave based non-linear junction detectors.

The operating principle of the detector is based on the alteration of the probing radio signals resulting from the non-linear character of semiconductors present in the target. The NR-μ will detect all semiconductors including transistors, diodes and silicon chips, irrespective of whether they are switched on, off or in sleeping mode.

NR-μ non-linear junction detector (STT Group) 0573708

Specifications
Antenna
polarisation: circular
ellipticity ratio: not less than 0.75
gain of transmitting antenna: not less than +6 dB
gain of receiving antenna: not less than +8 dB
Output
audio: tone (400 Hz)
display: 2 × 16 dot LED scale
Power supply: 6 V (2 battery packs)
Battery life: 5 h in sweep mode
Dimensions
antenna head diameter: 194 mm
extendable handle: max 980 mm
transceiver unit: 177 × 140 × 60 mm
device in carrying case: 485 × 390 × 140 mm
Operating temperature: +5 to +50°C
Weight
handle with antenna head: 1.1 kg
transceiver unit: <1.7 kg

Status
In production and in service.

Contractor
STT Group.

NR 900 EM and NR 900 EMS Professional non-linear junction detectors

Description
The NR 900 EM non-linear junction detector is designed to detect concealed electronic devices containing semi-conducting components. The device allows the inspection of buildings, including walls and furniture, and the detection of covert surveillance devices, such as radio microphones and microphone amplifiers, in different operational modes.

The operating principle of the detector is based on the alteration of the probing radio signals resulting from the non-linear character of semiconductors present in the target. The NR 900 EM will detect all semiconductors including transistors, diodes and silicon chips, irrespective of whether they are switched on, off or in sleeping mode.

Simultaneous reception of the second and third harmonics allows the user to screen out 'false' semiconductors created by ferrous materials.

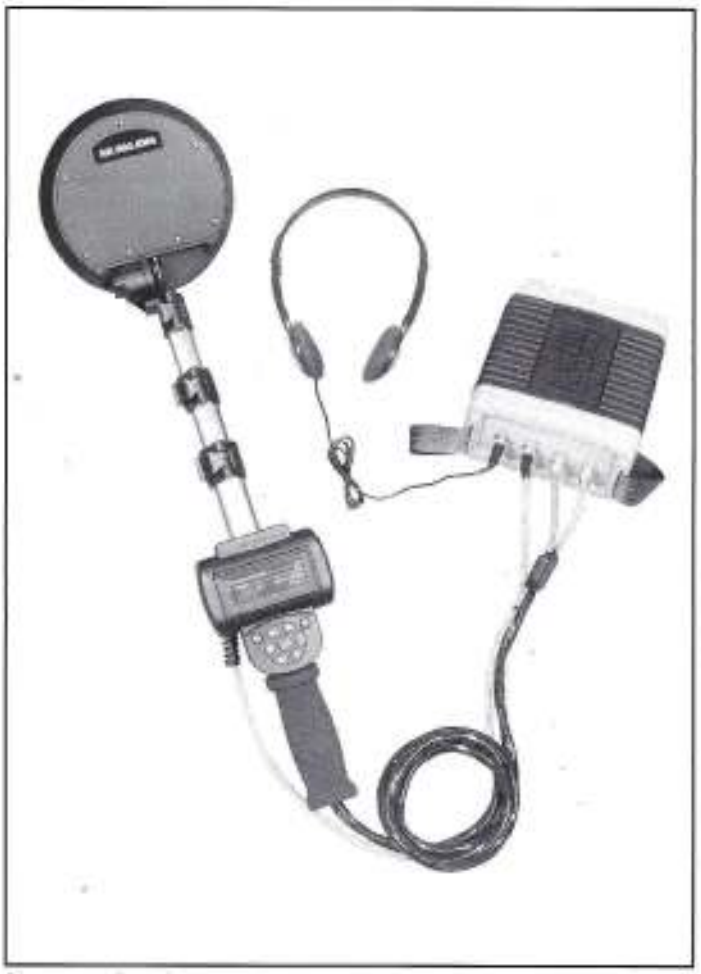
The high energy potential of the detector provides for effective detection of electronic devices inside heavy building constructional elements, including on the far side of reinforced walls. The device has a high speed sweeping capability and the receivers are protected against interference from GSM-1800 cellular phone signals.

A new generation of this detector has been produced and is dubbed the NR 900 EMS Professional. The primary upgrades in this new model include a more ergonomic design and a higher noise immunity, now with absolute protection against any standard of mobile phone communication. The NR 900 EMS is also completely digital and has an improved signal's curve extraction mode (20K).

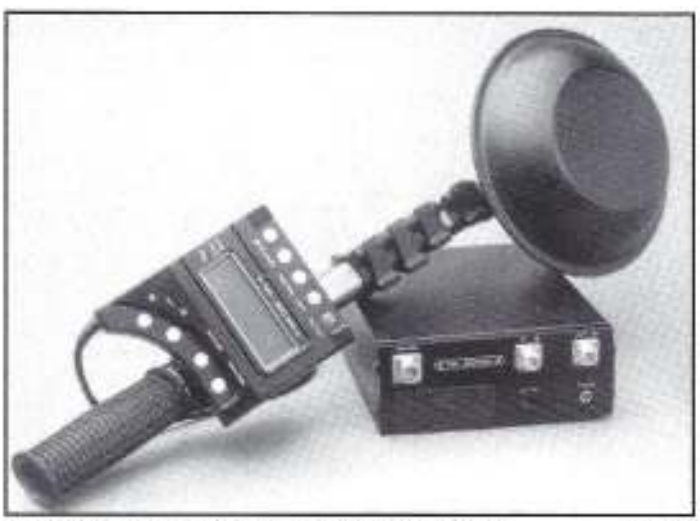
Specifications
Details of the NR 900 EMS in parentheses where available
Transmitter
frequency: 860 MHz (848 MHz)
power: peak pulse 200 W, +53 dBm
modulation: amplitude – pulse, duty cycle 1500
Receivers
frequencies: 1,720 MHz, 2,580 MHz
sensitivity: not less than –123 dB/W (–150 dBW)
attenuator levels: –10, –20, –30, –40, –50 dB
Output
audio: tone, 212 Hz
display: 4 row LCD
Power requirements
AC: 220 V, 50–60 Hz,external AC/DC adaptor
battery: 12 V, 2 battery packs
battery life: 4 h continuous (not less then 8 h in searching mode and 4 h in 20K mode)
Dimensions
antenna head diameter: 194 mm
extendable handle: 980 mm (maximum)
transceiver unit: 215 × 162 × 63 mm
device in carrying case: 540 × 420 × 150 mm
Operating temperature: +5 to +50°C
Weight
handle with antenna head: 0.8 kg (1.5 kg)
transceiver unit: 2.2 kg (not more than 2.2 kg)
ready to use (with battery): 3.3 kg
device in carrying case: 8.4 kg

Status
In production and in service.

Contractor
STT Group.



NR 900 EMS Professional non-linear junction detector (STT Group) 1323703



NR 900 EM non-linear junction detector (STT Group) 0573710

NR 900 EK 'Eagle' non-linear junction detector

Description

The NR 900 EK 'Eagle' non-linear junction detector was designed for the detection of remote-controlled explosive devices and other types of devices with electronic circuitry such as remote controlled receivers, transceivers, electronic fuzes and electronic timers. It can also be used for mine detection and is particularly suited to the detection of hidden arms caches.

The operating principle of the detector is based on the alteration of the probing radio signals resulting from the non-linear character of semiconductors present in the target. The 'Eagle' will detect all semiconductors including transistors, diodes and silicon chips, irrespective of whether they are switched on, off or in sleeping mode. All controls and a handle are located on the antenna head.

Simultaneous reception of the second and third harmonics allows the user to screen out 'false' semiconductors created by ferrous materials.

The system has been specifically designed for military, outdoor use, being usable in a wide range of temperatures and, the manufacturer claims, dust-proof and shock-proof.

Specifications

Probing signal type: pulse
Probing signal power in pulse
maximum: 200 W
average continuous: 0.15 W
Receiver sensitivity: not less than –150 dB/w
Power supply: 6 V battery (2 battery packs)
Battery life: at least 10 h
Operating temperature: –30 to +50°C
Weight
antenna head, with handle: 0.9 kg
transceiver: 1.6 kg
ready to use device (with battery): 4.3 kg
device in carrying case: 12.5 kg

Status

In production and in service with state-run organisations, security services, anti-terrorist units and engineer troops.

Contractor

STT Group.

The 'Eagle' was designed for use by engineer troops (STT Group)
0074838

NR 900 EK 'Eagle' non-linear junction detector (STT Group)
1178162

NR-900V "Vector" non-linear junction detector

Description

The NR-900V "Vector" non-linear junction detector is intended for searching concealed electronic equipment that contains semiconductor elements, including devices such as:

- radio microphones ('bugs'), including those with remote control;
- microphone amplifiers of wired microphones;
- eavesdropping devices of infra-red and ultrasonic band;
- hidden sound recorders; and
- various other transistors, diodes and silicon chips.

The NR-900 V will detect all semiconductors irrespective of whether they are switched on, off or in sleeping mode and it ensures easy sweeping operation within building structures, furniture and other household articles and even body-worn items. Simultaneous reception of the second and third harmonics also allows the user to screen out 'false' semiconductors created by ferrous materials through the improved signal curve extraction mode (20K).

The major feature that differentiates the NR-900V from other, similar detectors is that the "Vector" is the first non-linear junction detector with automatic target identification capabilities against the corrosion diode background.

NR-900 V non-linear junction detector (STT Group) 1323702

Specifications

Transmitter
frequency: 848 MHz
maximum detection range: not less than 1 m
modulation: amplitude – pulse, 250 Hz
Receiver
sensitivity: not less than –150 dB
attenuator levels: –10, –20, –30, –40, –50 dB
Signal indication
audio: headphones
display: dual LED bar-graph
Power requirements
battery (supplied): GP 'VD-153' rechargeable
battery life:
searching mode: not less than 4 h
20K mode: not less than 1.5 h
Operating temperature: +5 to +40°C
Weight
main unit with battery: 1.8 kg
telescopic bar with antenna system: 1.1 kg
complete set in carrying case: 7.5 kg

Status

In production.

Contractor

STT Group.

United Kingdom

Buster K910B contraband detector

Buster K910B contraband detector 0004720

Description

The Buster contraband detector indicates the difference in density between contraband (drugs, explosives, weapons, currency) and the object within which the contraband is hidden; such as an 'empty' tyre filled with air as opposed to an 'illegal' tyre filled with drugs, or a hollow cross-member in a freight container stuffed with contraband. Buster was designed in conjunction with the US Customs Service, which has over 2,000 units. The unit is operationally proven and simple to use.

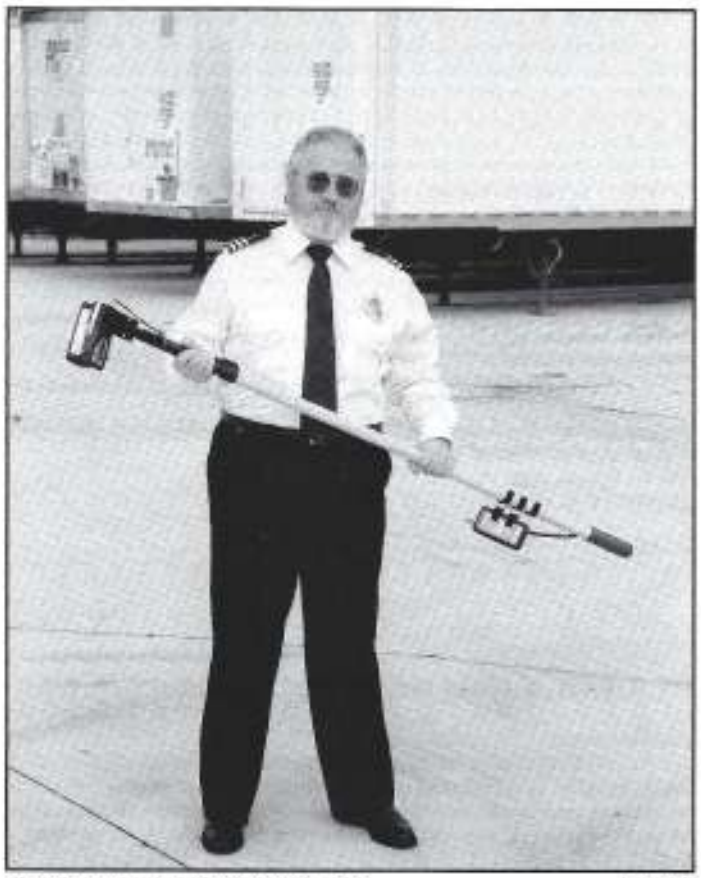
Buster directs a beam of energy into the object under inspection. A filled space reflects back more energy than an empty space. As Buster is moved across the surface of the object the measurement is displayed on a digital LCD screen, and an alarm sounds if the density changes. The operator can quickly and easily determine if an object is normal and not waste valuable time.

To search, the operator places Buster on the surface of a suspect area and holds it there for 2 seconds while the instrument 'normalises' to it. Then as Buster is moved across the object, differences in density are detected and indicated. Earphones allow the operator to work in noisy environments or in secret if necessary.

Buster's direct beam of gamma rays will penetrate the surface of an object. It can see through wood, metal, textiles, plastic and most other materials and will scan to a depth of 180 mm even through 7 mm steel plate. Since every material has a specific density, unexpected changes become obvious. The gamma rays cause no damage to the objects being inspected and are similar in size to those used in smoke detectors. An extension arm enables the inspector to reach otherwise inaccessible places while a remote reading display gives greater flexibility in use.

The widely used Buster is credited with finding many thousands of kilos of contraband, including narcotics, radioactive materials, explosives, weapons and currency. Simple and safe to use, Buster can be carried in a belt-holster and requires no specific training. It can be exported from the US without an export licence.

Accessories include a 5m telescopic extension pole and a remote display unit.



Buster mounted on the extension arm 0053802

Specifications

Dimensions: 140 x 64 x 64 mm
Weight: 1.10 kg
Display: 3½ digit LCD display, 0.5 s update
Batteries: disposable 9 V cells. Low-battery warning
Scan rate: 0.25 s
Depth of scan: 152 mm
Auto alarm: 1 standard deviation +1 count
Detector: cadmium telluride solid-state

Status

In production. Used by the US federal agencies, state and local police, Department of Defense and other international and intergovernmental agencies. It is exported to 75 countries worldwide.

Contractor

SDMS Security Product Ltd.

Guartel WD-100 Cable Detector

Description

The WD-100 cable detector is the latest addition to the Guartel range of metal and cable detectors. The WD-100 is able to detect the presence of both buried and surface laid cables. The WD-100 is lightweight, durable and easy to operate. The operator can use the unit for long periods over most terrains. The detector is powered by 3 standard LR20 batteries, which provide 8 hours of continuous operation. The WD-100 is supplied packed in a IP67 rated transit case and during operations the equipment can be carried in the water resistant haversack.

The WD-100 cable detector can locate to a minimum of 50 m of buried cable at a depth of 20 cm in most soil conditions.

WD-100 cable detector
(Guartel Technologies Ltd)
1289227

Specifications

Operating weight: 3.2 kg
Weight when in packaging case: 18.3 kg
NATO stock number: Z5 – 6695 – 99 – 509 – 7263

Status

In production.

Contractor

Guartel Technologies Ltd.

Merlin[133] contraband detector

Description

The Merlin[133] contraband detector is a portable, lightweight instrument that indicates the presence of hidden material by signalling unexpected changes in the density or thickness of a surface. For example, an 'empty' tyre filled with air will register a lower reading than one filled with contraband.

In operation the detector emits a beam of energy into the object being inspected and measures the backscatter. A filled space reflects more energy than an empty space. As the detector is moved across the surface of the object, the measured backscatter is displayed on an LCD digital readout and an alarm sounds if the reading changes. The narrow beam of gamma rays used to analyse the density or thickness of a surface is capable of penetrating many materials including wood, metal, textiles and plastics. With the exception of photographic and x-ray film, the gamma rays cause no damage to the objects being inspected.

The contraband detector also features a radiation detection function that allows the instrument to detect the presence of concealed radioactive material. Audio output resembles a conventional Geiger counter in this mode.

Two lengths of extension arm are available: 400 mm and 3 m. These allow otherwise inaccessible surfaces to be searched, such as the insulated walls of high-sided vehicles or ceilings within buildings. A remote display unit allows the operator to see and control all of the electronic functions of the instrument when using either of the extension arms, or simply when the main unit is inconveniently placed, such as under a car.

All instruments are calibrated against a universal standard. A serialised calibration block is supplied with each detector to enable the user to recalibrate in the field.

Specifications

Detector: thallium-doped caesium iodide scintillation crystal
Source: sealed barium[133]
Activity: 370 kBq (10 µCi)
Protective shielding: tungsten alloy
Audio volume: 88 dB pulse at 10 cm
Power supply: 2 × C cells
Battery life (alkaline batteries): 3–6 months normal day-to-day use
Main body dimensions: 110 × 65 × 60 mm
Handle length: 140 mm
Weight: 1.4 kg

Status

In production and in service.

The contraband detector indicates the presence of hidden material by signalling unexpected changes in density or thickness (Allen-Vanguard) 0528221

Contractor

Allen-Vanguard (formerly PW Allen & Company Limited).

RE 975 NLJF Field Non Linear Junction Detector

Development

The RE 975 NLJF can be deployed for a number of applications including: mine detection and detection of remotely controlled explosive devices in environments where there are many large metal objects for example, under railway lines, in vehicles and behind barriers (including reinforcement).

Description

The RE 975 NLJF is a long range system designed to detect the presence of electronic components in IEDs, in search and IEDD operations in the field. It is specially designed for military outdoor use and is provided in a solid case. It can be deployed upon a Mil Spec body vest which transfers the majority of the equipment weight onto the operator's body. All controls are located on the antenna search head.

Specifications

Dimensions
Antenna and Signal Processing Module: 250 (d) × (h) 170 mm
Transceiver module: 190 × 65 × 147 mm
Battery pack: 180 × 40 × 125 mm
Device in carrying case: 610 × 490 × 300 mm

Weight
Antenna and Signal Processing Module: 0.9 kg
Transceiver module: 1.6 kg
Battery pack: 1.7 kg
Ready to use device (with battery): 4.3 kg
Device in carrying case: 17.0 kg
Operating conditions
Operational temperature range: –30°C to +50°C
Limiting low temperature: –40°C
Limiting high temperature: +60°C
Humidity (at 25°C): 98%
Power requirement
Battery: 6 V (2 battery packs)
Continuous operations time from one battery pack: at least 10 h

Status

In production and in widespread service. Successfully deployed by EOD and Special Forces in live operations since 2001.

Contractor

Richmond EEI Limited.

Scanmail 10K mailscreening equipment

Description

Scanmail 10K is a microprocessor-controlled mailscreener which will reliably screen mail and courier deliveries up to about the size of a telephone directory.

The system will detect almost all common letter bomb components regardless of the type of explosive used, whether plastic or otherwise. Scanmail is programmed automatically to give alarm on packages containing potentially dangerous contents, such as explosive devices, while ignoring the normal office stationery items contained in mail such as paper clips, staples and metal tags.

A high level of selectivity is achieved without any loss of the forensic-standard protection it provides. The sensitivity level is set at the factory and cannot be reduced by users. A special test card is supplied to allow customers to check the correct functioning of the unit each time it is switched on.

Scanmail 10K mailscreening equipment 0516556

The system employs simple touchpad operation and requires no specialist training. It can run off an ordinary mains socket and also incorporates its own internal battery for use should the mains power fail. The unit is completely portable, emits no radiation and does not damage camera film, magnetic tape or computer disks.

Specifications
Power supply: 220 V/110 V, 50–60 Hz (switchable)
Integral battery: 12 V nominal DC, internally fused at 4 A
Operating temperature: 0 to +40°C
Length: 40 cm
Width: 45 cm
Height: 22 cm
Weight: 9 kg

Status
In production and in service.

Contractor
Scanna Msc Limited.

United States

Boomerang4

Development
The Boomerang4 is a non-linear junction detector that detects electronic circuitry used in Improvised Explosive Devices (IEDs). Detectable devices include electronic timers, remote-control receivers and certain types of triggering circuits.

Description
The Boomerang4 can be used in package screening and inspection where its hand-held antenna is used to detect electronic semiconductor devices. It can also be used in area clearing to detect circuitry in buried IEDs.

The equipment works by emitting a low-power microwave signal from its antenna. When the signal is received by a transistor, diode or other semiconductor, the signal is changed and the semiconductor radiates harmonics or whole-number multiples of the original frequency. The Boomerang4 detects these harmonics and gives the user an indication on the antenna-mounted signal strength meters.

The equipment can differentiate between semiconductors and oxidised metallic junctions by detecting two different types of harmonics. This technique can aid in finding the location of IEDs containing nails and other shrapnel-type materials.

The Boomerang4's highly sensitive receiver provides exceptional detection range using very little transmitter power. The model NJD-4 has a 100 mW transmitter. The model NJD-5 has a 500 mW transmitter.

Accessories include: headset, 110/220 VAC 50/60 Hz charger, two 7 in antenna cables, instruction manual, test target, shoulder strap and shipping case.

Specifications
Transmitter power
NJD-4: 100 mW
NJD-5: 500 mW
Operating frequency: 915 MHz
Receiver frequencies: 1830 and 2745 MHz
Antenna polarization: horizontal/vertical with lockable swivel mount
Power: internal rechargable gel-cell battery, external 12 V DC, 110–240 V AC
Operational weight: approx 7.2 kg

Status
Available.

Boomerang4 0053792

Contractor
Information Security Associates, Inc.

LAMD (Lightweight Airborne Minefield Detection) system

Development
The LAMD, formerly known as the Airborne Standoff Minefield Detection System (ASTAMIDS), was intended to be a highly reliable airborne minefield detection system which would provide a commander with the accurate location of minefields. The system was required to detect and identify the boundaries of buried and surface patterned minefields, as well as scatterable mines and detect individual buried nuisance mines on unpaved roads.

Following a development phase during which Northrop Grumman and Raytheon were contenders, in early 1994 Raytheon, Missile Systems Division, combined with Cambridge Parallel Processing (CPP) of Irvine, California, were awarded a USD1.52 million increment as part of a USD22,261,448 cost plus incentive fee contract. This was to develop LAMD further over a 32-month demonstration and validation period, during which the system was to be demonstrated with a surrogate air vehicle and a mobile display station. At the end of that period a single Engineering and Manufacturing Development contract was to follow until the end of 1999, with production scheduled for the beginning of 2000. Some trials were conducted in Bosnia, but the system was not adequately proven.

The contracting activity was the Countermine Division of the NightVision and Electronic Sensors Directorate (NVESD), Fort Belvoir, Virginia. Project Manager is the Office of the Project Manager for Mines, Countermine and Demolitions, Picatinny Arsenal, New Jersey.

Description
LAMD was to be an airborne mine detection system consisting of an imaging sensor mounted on an unmanned aerial vehicle (UAV) and a processor/algorithm integrated into the UAV ground control station (GCS). The system would allow commanders to obtain information for formulating an operational plan and gather further information to modify that plan still more.

The sensor, weighing less than 45 kg, would be mounted on the UAV and controlled by the UAV GCS, transmitting minefield imagery via

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a datalink to the GCS for processing in near real time by a very high-speed parallel processor from CPP. The latter involves a Distributed Array Processor (DAP) with a growth capability of up to 450 per cent. The resultant information would be displayed and disseminated to users in a manner similar to other reconnaissance, intelligence, surveillance and target acquisition data.

The initial design included a Raytheon-developed sensor system involving laser diode technology, including a laser receiver and a UAV-mounted passive farband infra-red and active laser sensor detection system. The ground-based portion of the system included the Minefield Detection Algorithm and Processor (MIDAP).

Status
Development currently halted.

Contractor
Raytheon, Missile Systems Division.

P&LBD-400 letter bomb detector

Description
The P&LBD-400 is a letter bomb detector built into a portable briefcase. It electronically screens mail for the presence of explosive devices, an audible alarm alerting the user to the presence of an explosive device.

Letters and parcels are passed on top of a gate and analysed for the presence of explosive materials, electrical triggering devices and other ferrous elements used in the construction of a letter bomb.

The P&LBD-400 comes with a fully adjustable sensitivity control in order to calibrate the unit. The package and letter bomb detector is easy to use and can be operated by an individual without previous technical training.

Status
No longer in production.

Contractor
Homeland Security Strategies Inc.

P&LBD-400 letter bomb detector
0515786

Sceptor SpinCon® advanced air sampler

Development
Originally developed by Midway Research Institute, SpinCon® is a portable wet concentrator sampler that captures air samples to create a concentrated liquid sample. The system is able to address a broad range of air sampling requirements, being able to collect and concentrate particles down to 0.2 microns, including vapour traces from explosives.

Description
Sampling the air at a rate of 450 L/minute, SpinCon® provides 10 ml samples that can then be analysed. Sampling time can be varied between 5 minutes and 6 hours allowing for both intermittent and continuous monitoring.

The liquid samples collected by the system are concentrated by retaining particles in the sample, providing a concentration many times greater than in the air. Samples fall within the detection limits of most sensitive detection systems, even where the target sought it in low ambient concentrations. Compatibility with most detection technologies and platforms allows for the collected liquid samples to be used in both explosive and NBC detection. The SpinCon® has successfully captured volatile compounds such as Sarin (GB), semi-volatile compounds such as organophosphonates (for example VX and DIMP), and non-volatile compounds such as BZ and TNT.

Specifications
Power supply: 120 V AC or 12/24 V DC
Power consumption: 450–500 W
Operating temperature: 2 to 50°C
Size: 457.2 × 381 × 203.2 mm (18 × 15 × 8 in)
Weight: 20.9 kg
Flow rate: 450 L/min
Sample size: 10 ml

SpinCon® (Sceptre Industries Inc) 1334724

Status
In production and currently used in several military and civilian applications.

Contractor
Sceptor Industries, Inc.

EOD TOOLS AND EQUIPMENT

Canada

EOD Crimper

Description
ICOR's multi-purpose, aluminium, EOD hand-tool combines a Cap Crimper with Powder Punch and Tube/Fuse cutter which minimises the number of tools a bomb technician needs to carry. Designed for single-handed operation, the EOD Crimper makes a single crimp in one motion. The crimper insert is made of stainless steel and is replaceable. The replaceable cutting blade insert will easily handle Nonel tube and fuse and detonation cord from 1/16 inches to 3/16 inches in diameter. The cutting base is notched to allow powders to be released as the fuse or cord is being cut. The Powder Punch is stowed inside the handle and flips outwards when required. The EOD Crimper can be used for European and North American sized blasting cable.

Status
In production.

Contractor
ICOR Technology Inc.

EOD Crimper
(ICOR Technology Inc)
1299273

Hazardous Device Technician, (HDT) tool kit

Description
The HDT tool kit comprises an assortment of tools used for the most common EOD/Improvised Explosive Device Disposal (IEDD) response operations and post-blast analysis.

The kit contains 38 hand tools, including various pliers, wrenches, scissors and vice-grips. The rust-resistant tools are stored in a double-roll case made of durable nylon.

Med-Eng also offers non-magnetic tool kits.

Status
No longer in production.

Contractor
Med-Eng Systems Inc.

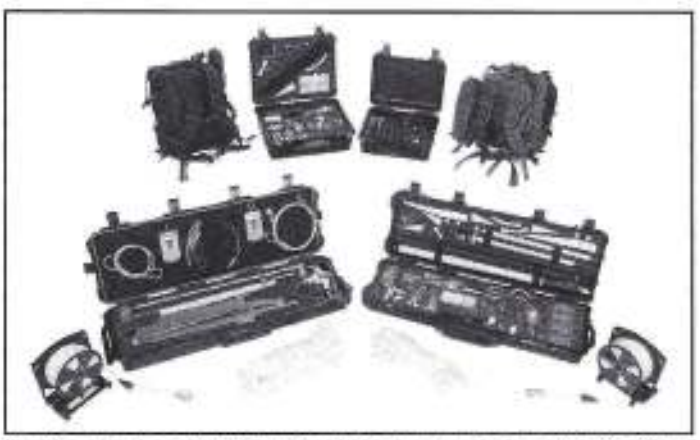
HDT tool kit
(Med-Eng Systems)
0125372

Hook and line kits

Description
Med-Eng produces Hook and Line Kits in five configurations, the GS1 and GS2 General Service Hook and Line Kits, Backpack Hook and Line Kit, Booby Trap Kit and Heavy Rural Kit. Their components have been re-designed in order to offer better use of the surroundings on-site and to allow connectivity of different parts. Improvement within the series include suction cups that can be used in tandem on uneven planes or individually in small spaces, hooks that allow clinical application with minimum of risk to the operator and a new hook setter to ensure precision deployment of the hooks themselves. Self-Opening Pulleys also now have a locking mechanism and the reel stand has been re-designed to allow it to be deployed on its side, eliminating the risk of it being tipped over.

The Backpack Hook and Line Kit offers a more portable option and contain components usually used in post-blast investigation.

The Clamp Kit's components integrate with Med-Eng's hook and line kits to attach to and remotely open vehicle doors, windows and boots/trunks. The Clamp Kit's components can also be used in building clearance operations.



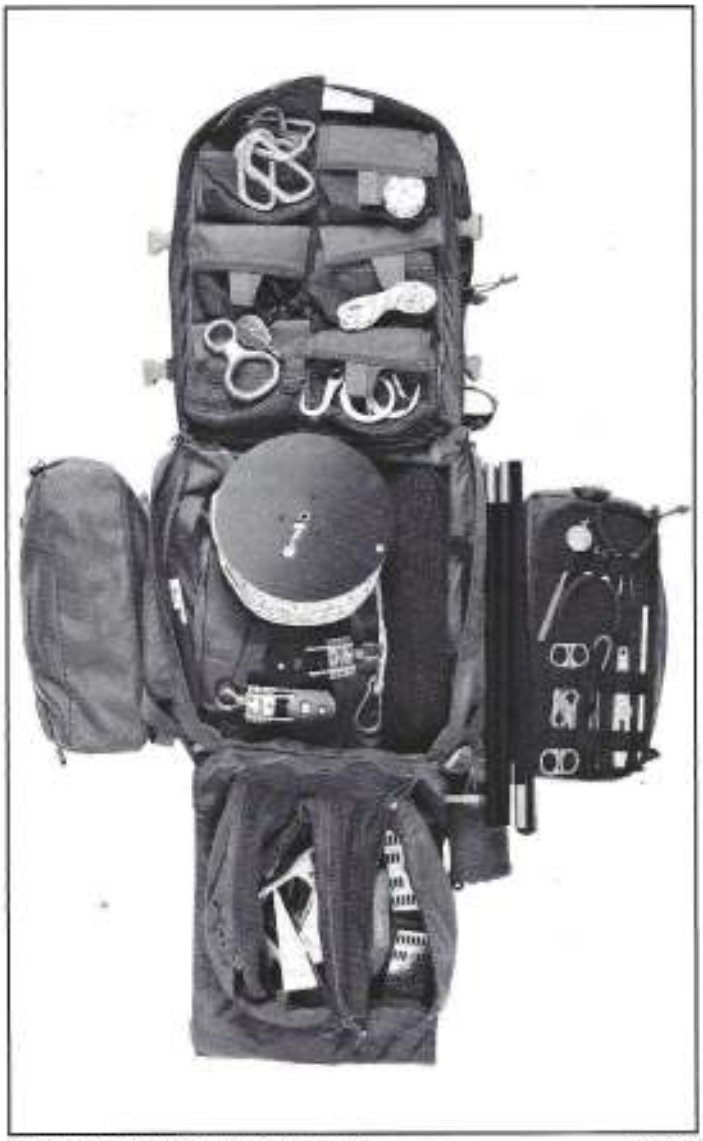
Med-Eng Hook and Line Kits: (clockwise from top) Backpack, GS1, Clamp Kit, Booby Trap Kit, GS2 and Heavy Rural Kit (Med-Eng Systems Inc.)
1311315

Backpack Hook and Line Kit (Med-Eng Systems Inc) 1299261

Specifications
Available upon request.

Status
In production and in service.

Contractor
Med-Eng Systems Inc.



Booby Trap Kit (Med-Eng Systems Inc) 1299260

Hook and Line Set

Description
ICOR's Hook and Line sets provide semi-remote handling capabilities for bomb technicians. The sets are available in two versions, the Ultimate (two line comprehensive kit) and Essential (single line basic kit) allow users to attach, anchor, redirect, reach and manoeuvre suspect EOD/IEDD devices.

Both versions use precision engineered components which are designed to endure the demands and dangers of EOD missions. They feature high strength, low stretch, colour-coded Kevlar® core lines and have lockable, self-opening pulleys. The sets come complete in a hard shell Pelican® carrying case.

Status
In production.

Contractor
ICOR Technology Inc.

Ultimate: Two Line Comprehensive Kit (ICOR Technolgies Inc) 1299274

Hotstic robotic manipulator

Description
The Hotstic robotic manipulator allows the EOD operator to respond to suspected explosive devices at a safer standoff distance. The Hotstic provides up to 3 m standoff distance by means of aluminium tubing sections that snap together to form the pole. No tools are required to assemble the Hotstic.

The electronic claw opens, closes and rotates. The Hotstic also provides manual pitch adjustment and has a protective breakaway tip and hand shield to increase operator safety in case of unplanned detonation. A shoulder harness and pole counterweight make operation more comfortable and energy-efficient.

The Hotstic operates on a rechargeable 12 V battery system. It can be disassembled for compact storage in a rugged Pelican case or for transport in compact response vehicles.

Specifications
Weight: approx 13 kg
Load (max): 16 kg
Length (max): 3 m
Claw opening: 200 mm
Power supply: 12 V rechargeable batteries
Storage case dimensions: 180 × 440 × 940 mm
NATO stock number: 1385-21-910-7253

Status
In production and in service.

Contractor
Med-Eng Systems Inc.

Hotstic robotic manipulator in transit case (Med-Eng Systems Inc) 0098423

Hotstic can manage loads up to 16 kg (Med-Eng Systems) 0126377

P Series generator blasting machine/exploder

Description
Available in one- and two-line systems, P Series handheld machines have an output of 100 V (minimum) and an energy output of 2 joules per line. The generator is of the permanent magnet type and the built-in galvanometer and line check require two silver oxide batteries. The machine is water- and impact-resistant, operating in temperatures from –45 to +75°C. Instantaneous discharge is achieved by removing the handle.

Specifications
Output: 100 V (minimum)
Operating temperature: –45 to +75°C

Status
In production. In service in North America and worldwide.

Contractor
Proparms Limited.

P1 blasting machine/exploder (Proparms Ltd) 1376003

Remote Entry Device (RED)

Development
The Remote Entry Device (RED) was designed to provide rapid, remote entry into the trunks of suspected vehicle bombs and to cut observation portals into the sides of vans, trucks and cars, all without the use of explosives.

Description
The RED is an enclosed cylinder containing a piston attached to a piston rod, to which a specific head is attached. All of the heads are interchangeable. An electrically-primed round of ammunition is used in conjunction with a Proparms Disrupter Breech to deploy this equipment.

No heat, flame, or sparks are used, and its safe and easy operation ensures end-user safety and efficiency.

The device can also be used as an alternative means to the battering ram and other forced entry devices (explosive or non-explosive), enabling quick entry through doors and into rooms. The RED can be deployed by a robotic platform, allowing the user to remain at a safe distance from the suspect vehicle or doorway.

Remote Entry Device (RED) (Proparms Ltd) 1298256

Specifications

Length:

(total tool)[2]	116.8 cm
(with Piston Rod extended)	144.8 cm
(basic tool)[1]	59 cm

Diameter: 8.9 cm

Weight:

(basic tool)[1]	9 kg
(total system)[2]	13 kg
(guide nut assembly)	1 kg
(carry assembly)	0.4 kg
(piston rod assembly)	2.2 kg
(cutting head weldment)	1.65 kg
(trunk/hood head weldment)	1.1 kg
(long leg: 25.4 cm)	1 kg
(medium leg: 15.2 cm)	0.6 kg
(leg sleeve: to join 2 legs)	0.15 kg
(short leg: 5.1 cm)	0.2 kg
(foot weldment)	0.8 kg
(breech assembly)	0.6 kg

Composition: stainless steel and aluminium

Ignition voltage: P-series blasting machine; 24 V DC, 1 A

Notes:

[1]Cylinder assembly and guide nut assembly (no head, leg or foot attached)

[2]Cylinder assembly, all legs, foot and heads

Status

In production.

Contractor

Proparms Ltd.

Remote Entry Device (RED) (Proparms Ltd) 1376005

Search/inspection mirrors

Description

Med-Eng produces a range of search/inspection mirrors for rapidly searching difficult access areas and for reducing an operator's exposure to the direct force of a blast. Each mirror includes a lightweight aluminium shaft with a convex mirror. Some models include a torch, which can be mounted onto the mirror pole to enable the operator to work in low light areas.

A number of mirror configurations are available.

Specifications

Available upon request.

Status

No longer in production.

Contractor

Med-Eng Systems Inc.

Med-Eng produces a range of search/inspection mirrors (Med-Eng Systems) 0125383

Search lights

Description
Med-Eng's search lights readily attach to its EOD-8, EOD 7B and SRS-5 helmets, to free the user's hands and provide focused illumination during operations in low-light conditions.

Lightweight, rugged and water-resistant, these search lights are designed to slide off after impact with a solid object to reduce any risk of injury to the operator.

The manufacturer advises, however, that if the presence of photoelectric cell-activated explosive devices is suspected, search lights are unsafe and should not be used.

Specifications
Details are available on request.

Status
In production and in service.

Contractor
Med-Eng Systems Inc.

Helmet-mounted search lights give the operator hands-free lighting
(Med-Eng Systems Inc) 0098409

Stealth Search Mirrors

Description
ICOR Technology has three different variants in their family of search mirrors, the M1000, M2000 and M3000. The mirrors are ideal for searching when there is a requirement to view under vehicles, around corners and ceilings. The mirrors are manufactured from durable, lightweight, ergonomic, non-rotational aluminium poles. Forearm supports and foam grip handles provide precise control and minimise operational fatigue.

ICOR Stealth Search Mirrors are used by EOD technicians, law enforcement agencies, security guards and facility inspectors.

Variants
M1000
The Stealth M1000 is designed for viewing the undercarriage of vehicles. A large 30 cm convex mirror along with the aid of a bright 4 LED light assembly, provides the operator with a quick view.

M2000
The Stealth M2000 has added features and the mirror pole can be extended up to 203 cm in length. The M2000 can be manoeuvred to view areas that are far-removed or difficult to access, such as attics and ceilings. This mirror is balanced to look around corners using one hand whilst leaving the other hand free for personal protection.

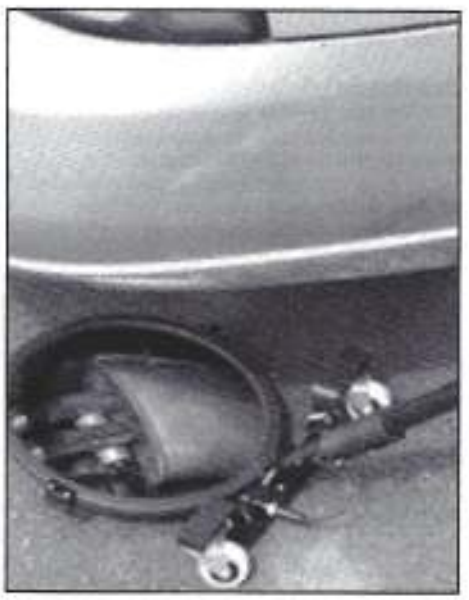
M3000
The Stealth M3000 is compact and consists of a three-piece telescopic, non-rotational, lightweight aluminium pole which extends to 101 cm. This model is suitable for general use.

Specifications

	M1000	M2000	M3000
Length:	63.5 to 167.5 cm	76 to 203 cm	53 to 101 cm
Weight:	3.2 kg	2.0 kg	1.2 kg
Diameter:	30 cm	20 cm	20 cm
Lighting:	Bright LED light bar (x 2), 15 hrs run time	Bright LED light bar, 15 hrs run time	10 hr halogen light

Status
In production.

Contractor
ICOR Technology Inc.



Model M1000 (ICOR Technology Inc) 1299270

Model M3000 (ICOR Technology Inc) 1299272

Model M2000 (ICOR Technology Inc) 1299271

TM-500C telescopic manipulator

Description
The TM-500C telescopic manipulator allows operators to respond to suspect explosive devices at a safer standoff distance.

The TM-500C provides up to 3 m standoff by means of lightweight aluminium, telescopic poles. The pole can be retracted or extended at any time during the operation in order to move through confined spaces such as stairways or hallways. It has a protective breakaway tip and hand shield to increase user safety in case of detonation. The manipulator features adjustable claw orientation and variable claw speed (release/contract).

The TM-500C is powered by a rechargeable 'C' cell battery system. A shoulder harness (nylon webbing) and pole counterweight make operating the manipulator more comfortable and energy-efficient.

Specifications
Approximate weight: 15 kg
Load (max): 10 kg
Length (max): 3 m
NATO stock number: 1385-21-920-3290

Status
In production and in service.

Contractor
Med-Eng Systems Inc.

The TM-500C allows the operator to work at safer standoff distances (Med-Eng Systems)
0532029

Trooper remote engagement system

Description
The Trooper remote engagement system allows an EOD operator to attach a robotic claw to a suspect or confirmed explosive device and manipulate it from a safer distance.

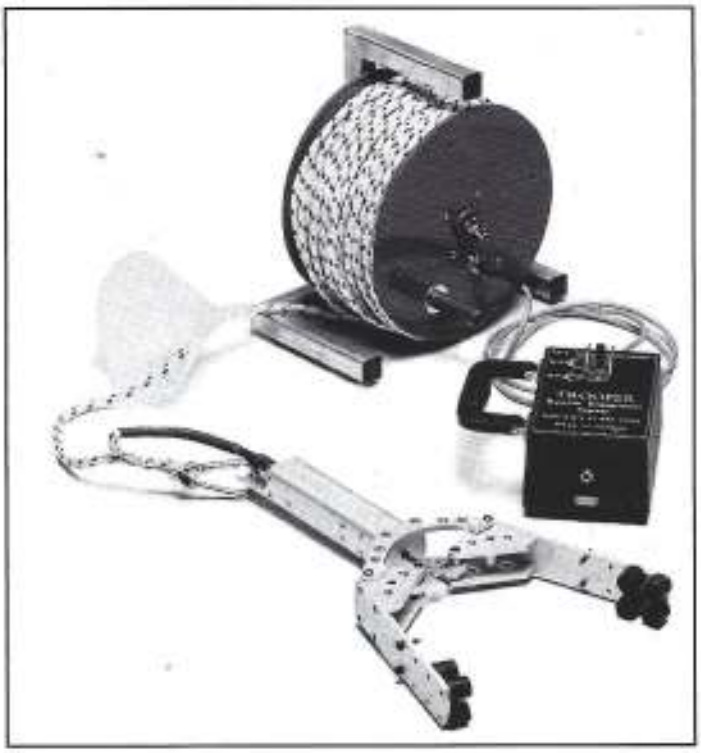
The claw attaches to Improvised Explosive Devices (IEDs) of a variety of shapes, sizes and materials, including typical pipe bombs, irregularly shaped packages, shoulder bags and briefcases. The clamping force of the claw is up to 45 kg.

The claw can be deployed manually or using a manipulator such as the TM-500C or the Hotstic (see separate entries). The line reel allows for up to 100 m of standoff distance. The Trooper operates on a rechargeable 12 V battery system.

Specifications
Approximate weight: 10 kg
Power supply: rechargeable 12 V battery system
Line length: 100 m
Clamping force: 45 kg
NATO stock number: n/a

Status
In production and in service.

Contractor
Med-Eng Systems Inc.



Trooper remote engagement system (Med-Eng Systems Inc)
0098419

Denmark

EOD tool kits

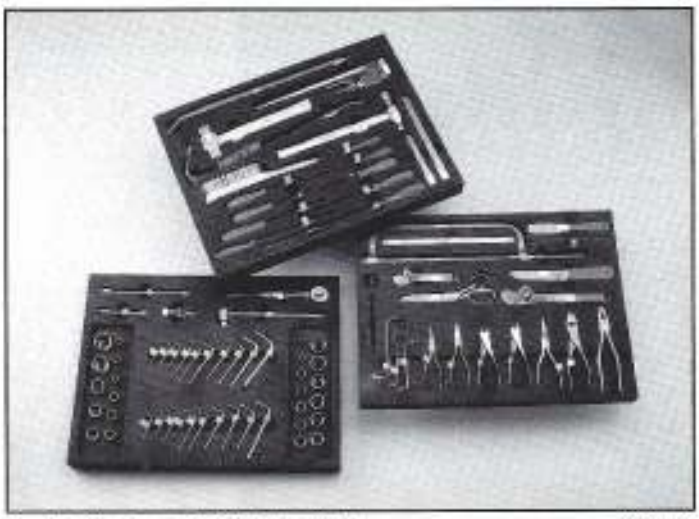
Development
Carltsø EOD tools are marketed worldwide and are used where there is a risk of fire or explosion or where there is special demands for non sparking non magnetic or corrosion resistant tools.

Description
Carltsø produces hand tools especially developed for EOD use. High quality and safety are seen as paramount in the tools' manufacture and all Carltsø Safety Tools' products are manufactured in accordance with OSHA standards and ISO and DIN norms.

The range includes all types of spark-resistant tools such as brushes, chisels, chain hoists, crowbars, hammers, pliars, saws, scrapers, screwdrivers, sockets, spanners and wrenches.

Status
In production. Carltsø's tools are in service with numerous organisations and companies, including NATO.

Contractor
Carltsø Safety Tools ApS.



Carltsø 84-piece tool kit (Carltsø ApS) 0074413

Germany

ASW-1 EOD tool set

Development
This non-magnetic EOD/Improvised Explosive Device Disposal (IEDD) beryllium/copper tool kit, housed in a robust compartmentalised aluminium transit case, includes a wide range of hand tools commonly used by operators.

Description
The set contains a 12-piece set of wrenches, a seven-piece set of screwdrivers, a five-piece set of drift punches, two sizes of cape chisels, two sizes of flat chisels, scissors, pointed pliers, two sizes of flat-nose pliers, round-nose pliers, snap-ring pliers, front-cutting nippers, a side cutter, universal pliers, a flat spatula, a knife spatula, two sizes of hammer, a steel brush, a square scraper, a blunt scraper, a magnet, an eight-piece set of hexagonal socket wrench heads, a clamp, a hook wrench, a pipe wrench, metal shears, a polygrip wrench, a socket wrench, an angle spike and a socket driver.

Status
In production.

Contractor
Force Ware GmbH.

Non-magnetic tool kit (Force Ware) 1344072

Comprehensive hook and line kit

Description
This comprehensive hook and line kit from Force Ware contains a range of equipment for gaining access to and dealing with improvised explosive devices and other UXO.

The set includes: two reels, two lines fitted with snap hooks, two rope pulling handles, two snatch blocks, 10 hooks in a range of sizes, hook accessories, two eyes, six rope slings, three wire slings, three pitons, two anchors for 8 mm holes, suction pad, two cantilever clamps, two lightweight spring grips, self-locking forceps, self-locking mole grip, 12 self-tapping screw eyes, adjustable clamp, nine karabiners in a range of sizes, four shackles, multifunction pocket tool kit, two stainless steel extension rods, telescopic pole, security mirror, belt sling, jammer cleat pulley, four self-relieving snatch blocks, two splitter balls for self-relieving snatch blocks, 10 self-adhesive anchor pads, doorway anchor, sledge and four doorstops. The kit is housed in a plastic case and has separate reel bags.

Specifications
Total weight of kit: 23 kg

Status
In production.

Contractor
Force Ware GmbH.

The hook and line kit contains a wide range of equipment (Force Ware) 1041283

EOD Trailer

Development
The EOD Trailer was designed for the safe transportation of devices suspected to contain explosive up to 6 kg TNT.

Description
The construction of the trailer allows the operation also in off-road areas (for example in combination with a small towing vehicle such as a jeep). It can be used with a larger towing vehicle such as a truck. The trailer consists of a solid steel frame installed on two spring-mounted axles. The frame carries a funnel shaped container.

An adjustable lifting mechanism on the right-hand side of the container allows loading and unloading of the container from a safe distance (up to 50 m) using a rope. The exchangeable and height adjustable tow-bar allows the adapation of the trailer to the towing vehicle which is used. As standard, two types of couplings are available: a towing ring and a ball-shaped coupling.

The connector is a 7-pin plug as standard. An adapter 13 pin to 7 pin comes as standard. A lockable metal container for storage and transport is mounted on the trailer to keep the necessary accessories and spare parts.

Specifications
Length: 4,100 mm
Width: 2,200 mm
Height:
(inserted lifting mechanism) 1,900 mm
(extended lifting mechanism) 3,100 mm
Weight: 1,400 kg

EOD Trailer (Force Ware GmbH) 1299287

Container: steel funnel, double wall, gap between walls with spaces
Loading/unloading: manually with ropes, from a max distance of 50 m

Status
In production.

Contractor
Force Ware GmbH.

Heavy duty EOD/IED tripod

Development
A heavy duty tripod designed specifically for EOD and IED applications.

Description
The head is extruded for strength and the unit is fitted with an integral pulley. The tripod is fitted with snap out legs for quick deployment which can be extended to different lengths to cope with sloping ground. The feet can swivel and may also be anchored with ground pins (supplied). A webbing strap is also provided, which may be passed around the feet to prevent the unit collapsing under load. The feet are fitted with eyes so that an extra pulley can be positioned to improve loading. There is a load indicating attachment eye which shows if there has been an unexpected fall of the object being lift. The tripod and accessories come complete in a cordura carrying bag.

Specifications
Legs/head unit: high strength aluminium alloy
Fittings: stainless steel
Safe working load: 700 kg with a 3:1 safety factor
Operational temperature: –20 to +54°C
Storage temperature: –20 to +54°C
Dimensions:
(short position) 1.7 m (h) × 1.1 m (l)
(extended position) 2.5 m (h) × 1.5 m (l)
(fully closed down) 1.8 m (h) × 0.4 m (l)
Weight: 17.5 kg

Status
In production.

Contractor
Force Ware GmbH.

Heavy duty EOD/IED tripod in use (Force Ware GmbH) 1299285

Top section of heavy duty EOD/IED tripod clearly showing pulley system (Force Ware GmbH) 1299286

HELIOS fuze extractor

Description
HELIOS allows the user to remove fuzes from a variety of ordnance from a safe distance. Two 12.7 mm or 20 mm cartridges provide the torque. The wrenches are equipped with both cylindrical and conical clamps to fit different types of fuzes.

Specifications
Dimensions, when deployed
length: 38 cm
height: 13 cm
width: 30 cm
Dimensions, when packed
length: 46 cm
height: 19 cm
width: 32 cm
Weight, when deployed: 5 kg
Weight, when packed: 13 kg
NATO stock number: 1385-12-327-8791

Status
Available.

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.

HELIOS and accessories (telerob) 0120992

Hook and line kit I

Description
This hook and line kit from Force Ware contains a range of equipment for gaining access to and dealing with improvised explosive devices and other UXO.

The set includes: 180 mm diameter reel with 100 m of 4 mm line fitted with a snap hook, secondary line, rope pulling handles, snatch blocks/pulleys, a range of hooks, eyes, belt slings and stainless steel extension rods. The kit is packed in a rigid plastic case.

Specifications
Total weight of kit: 8.4 kg

Status
In production. Still in use worldwide.

Contractor
Force Ware GmbH.

The hook and line kit I (Force Ware) 1041280

Hook and line kit II

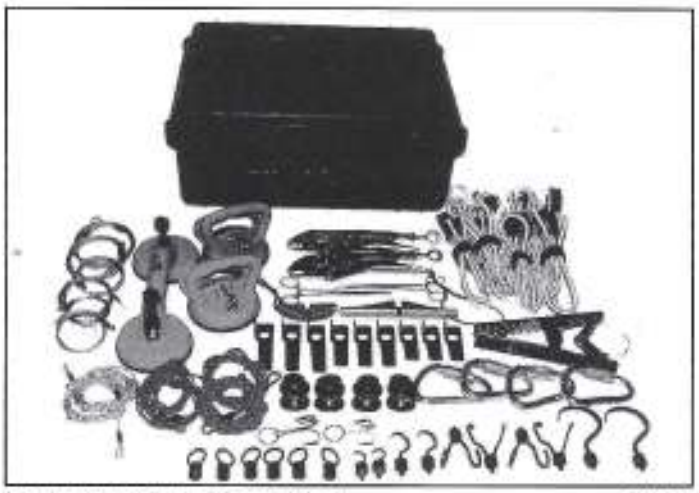
Description
This hook and line kit from Force Ware contains a range of equipment for gaining access to and dealing with improvised explosive devices and other UXO.

The set includes: two reels, 120 m of 5 mm line fitted with a snap hook, rope pulling handles, snatch blocks/pulleys, a range of hooks, eyes, rope and wire slings, pitons, suction pads, screwgate karabiners, shock cords, cantilever clamps, cantilever clamp key, self-locking forceps and self-locking mole grips. The kit is packed in a rigid plastic case.

Specifications
Total weight of kit: 12.6 kg
NATO stock number: 1385-99-787-3640

Status
In production.

Contractor
Force Ware GmbH.



The hook and line kit II (Force Ware) 1041279

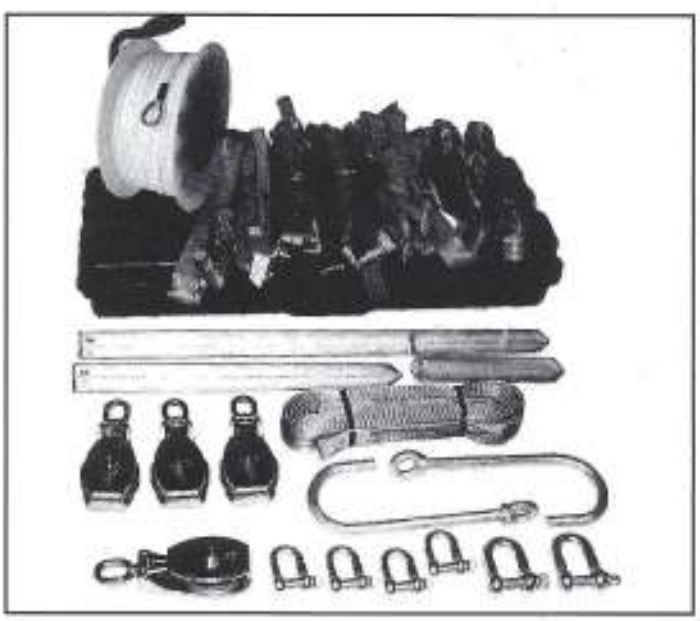
Hook and line kit III

Description
This heavy duty hook and line kit is intended for use moving vehicles or heavy suspect devices. The kit contains a range of rated slings and heavy-duty snatch blocks. It comes with a solid carrying case and 150 m of rope on a reel.

The set includes: 150 m reel with 8 mm low stretch line (4,500 kg strength), four webbing slings in two lengths (rated 2,000 kg), six round slings in three lengths (rated 1,000 kg), six ground anchors in three lengths, six D-shaped shackles in two sizes (rated 4,000 kg and 3,000 kg), four blocks with safety latch (rated 3,000 kg) and two hooks with eyes. NATO stock number: 1385-99-464-1274

Status
In production.

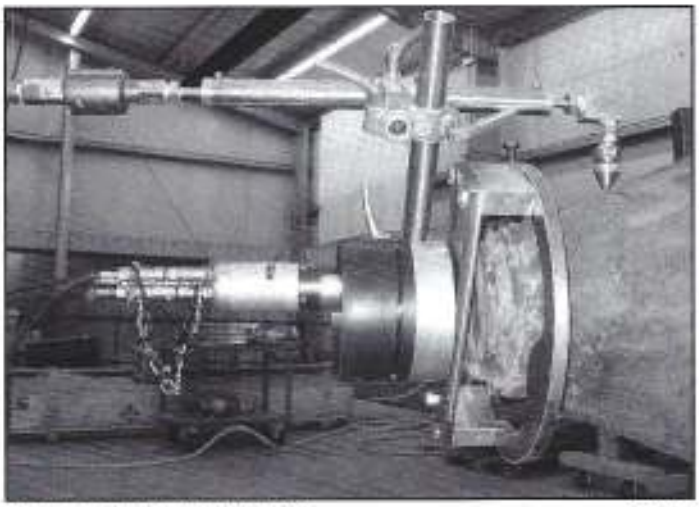
Contractor
Force Ware GmbH.



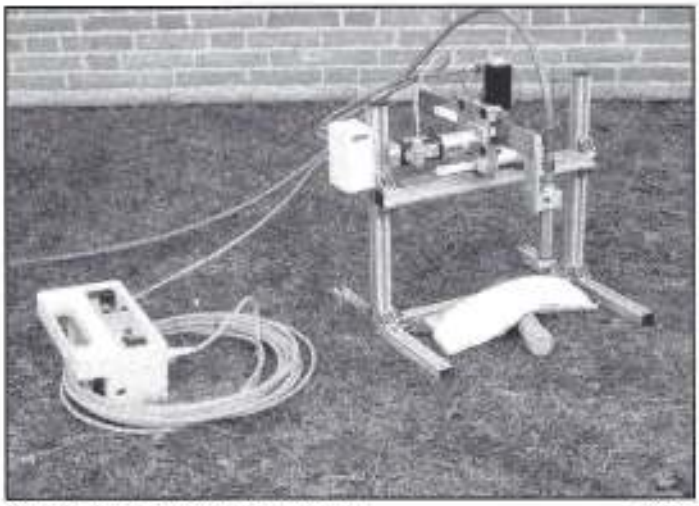
The heavy-duty hook and line kit III (Force Ware) 1041282

Manipulation systems and cutting tables

Description
ANT Applied New Technologies AG manufactures a number of cutters and manipulation systems. Its Circular Cutter easily and quickly cuts circular holes and its low weight and small size allows the user to fix the table in any cutting position – even at walls, ceilings and inclined surfaces. The height-adjustable structure is equipped with an electric drive. The 2-axis Cutting Table has been designed for 2-dimensional contours. It is extremely light and thus is easy to handle. ANT's Base Fuze Manipulator has been developed for cutting SAP, MC, GP and AP bombs. After application on the bomb base, the water abrasive jet severs the bomb base, inclusive of fuze. The manipulator is supplied as standard with a hydraulic drive but is also available with electric drive. Its modular construction and low weight design provide for flexible deployment. The MACE Cutting Table Light has been developed, like the Base Fuze Manipulator, for cutting SAP, MC, GP and AP bombs. However, it allows a contact-free cut, whereas the Base Fuze Manipulator is fixed at the bottom of the bomb. It does mean that an adequate solid ground base



Base Fuze Manipulator (ANT AG) 1041134



2-axis cutting table for IEDD (ANT AG) 1041135

is a pre-condition of use of the MACE Cutting Table Light. It is smaller and more flexible than the 3-axis cutting table of MACE (see separate entry) and allows conical, axial radial or axial parallel cuts of the bomb bottom.

Specifications

Circular Cutter
Working area (diameter): 0–250 mm, optional up to 800 mm
Drive: brushless CD motor
Traverse speed: 10–400 mm/min
Weight: 6.5 kg (+2 kg control panel)
Size: 730 × 630 × 560 mm

2-axis Cutting Table
Working area (diameter): 250 × 200 mm
Drive: brushless CD motor
Traverse speed: 0–750 mm/min
Weight: 6.5 kg (+2 kg control panel)
Size: 600 × 450 × 600 mm

Base Fuze Manipulator
Working area (diameter, cutting edge): 200–500 mm
Drive: hydraulic or electric
Traverse speed: 30–300 mm/min
Weight: 10 kg
Size: 300 × 150 × 100 mm
Adaptor flange: 5 diameter sizes, from 100 to 400 mm
Spacer: 3 different sizes, from 50 to 150 mm

MACE Cutting Table Light
Working area (cutting edge): 50–500 mm
Drive: hydraulic

Circular Cutter (ANT AG) 1041136

Traverse speed: 30–300 mm/min
Weight: 33 kg
Size: 860 × 860 × 1,110 mm

Status
Available.

Contractor
ANT Applied New Technologies AG.

MEL 112-1 Search Mirror

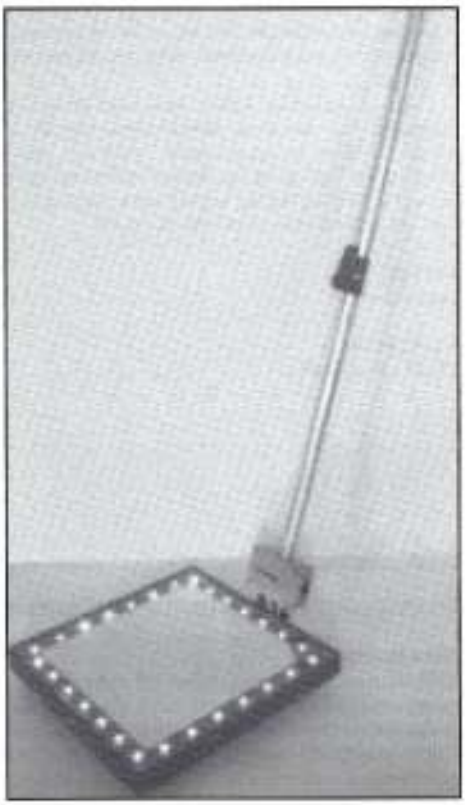
Description
The MEL 112-1 search mirror is designed to be extra large and break proof. The mirror system contains a telescopic barrel and battery charge as standard.

Typical applications include police, customs and similar, military (security and safety units) and under vehicle inspections.

Specifications
Accu-technology: Li-Ion
Operating time: 6–7 h (approx)
Charging time: 2 h (approx)
Telescopic barrel: 2 parts, 80+80 cm
Dimensions:
(length) 320 mm
(width) 320 mm
(height) 48 mm
Weight: 3.4 kg
Mirror: stainless steel, planar
Housing plastic, ALU
Roles: 4 pcs, solid rubber
Type of protection: IP64

Status
In production.

Contractor
MELTRON International Security Services GmbH.



MEL 112-1 search mirror (MELTRON International Security Systems) 1298744

MEL 112-2 Robotic Search Mirror

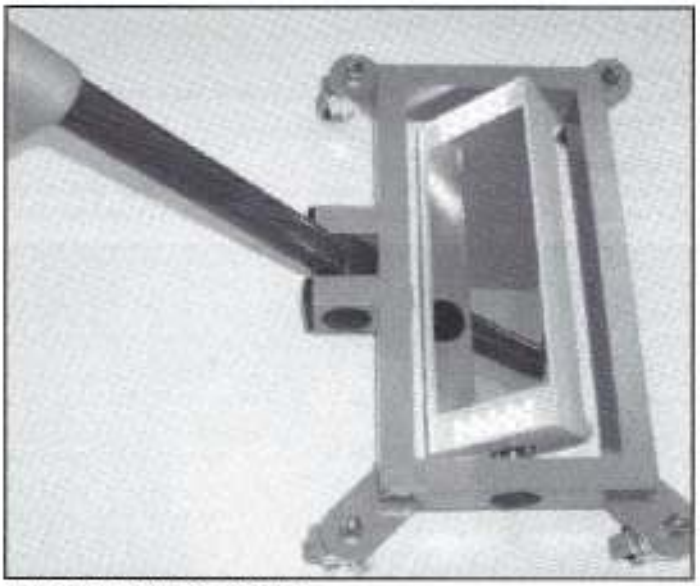
Description
The MEL 112-2 robotic search mirror is designed to be push-button controlled with LED-light and Li-Ion battery. The mirror system contains a telescopic barrel and battery charge as standard.

Typical applications include police, customs and similar, military (security and safety units) and under vehicle inspections. Transport box is available as an option.

Specifications
Accu-technology: Li-Ion
Operating time: 6–7 h (approx)
Charging time: 2 h (approx)
Telescopic barrel: 2 parts, 60+60 cm
Weight: <3 kg
Mirror: stainless steel
Housing: ALU
Roles: 4 pcs, solid rubber
Type of protection: IP64

Status
In production.

Contractor
MELTRON International Security Services GmbH.



MEL 112-2 Robotic Search Mirror
(MELTRON International Security Services) 1298745

MEL 244 Hook and Line Set

Development
The MEL 244 hook and line set was designed for military requirements in the field of improvised explosive device disposal (IEDD) and explosive ordnance disposal (EOD).

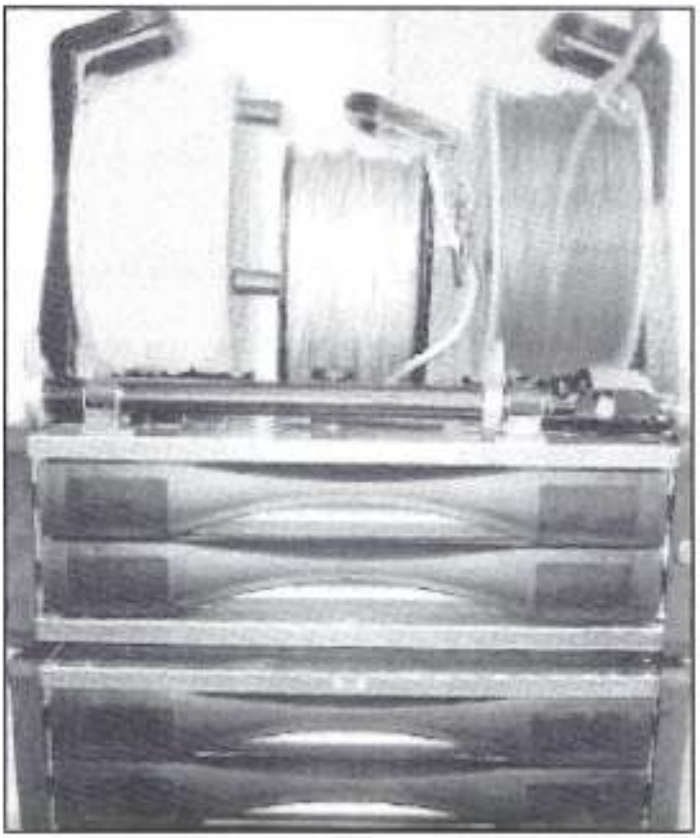
Description
The company claims that heavy objects (for example a car) can be pulled away with the MEL 244 hook and line set. The hooks and eyes are manufactured from high quality V4A steel and are resistant against salt water, chlorine and other aggressive matters, this makes the set suitable for use in maritime operations. Each wire (2 × 120 m, 1 × 70 m) is wound up with a rope drum. The wires have different colours and are provided with a steel loop. Each wire has a diameter of 6 mm and a breaking load of 2,750 kg. The self-opening snatch blocks are manufactured from aluminium and have a breaking load of 3,200 kg.

The remote key flip is made of aluminium and can be used for all types of keys. The manipulator bar is subdivided into 9 segments and produced in carbon which makes the bar lightweight. The carabiner are manufactured from steel and are appropriate for heavy loads. These are available in dimensions of 50, 80 and 120 mm and the hooks can manage a loading of 150 kg. The set comes with clamps which can also be used as a spreader. The lock grippers can be opened with one hand with a trigger function. The vacuum lifting pads contain flexible vacuum cups and can hold on to dented car body panels. These have a maximum weight of 30 to 120 kg. The combination tool is of an arm construction and is able to open vehicle doors, it can also be used to smash glass windows. The tripod is designed to unlock bonnets. A backpack is also available.

Status
In production.

Contractor
MELTRON International Security Services GmbH.

MEL 244 Hook and Line Set can be fitted into a backpack
(MELTRON International Security Services)
1298756



MEL 244 Hook and Line Set
(MELTRON International Security Services)
1298755

MEL 271 Rocket Wrench

Development
The MEL 271 rocket wrench is designed to screw out fuzes from large calibre ammunition.

Description
The fuze of the Rocket Wrench is propelled by 2 x 12.7 mm cartouches and remote controlled over ignition cables. The MEL 271 can be used with fuzes ranging from 35 to 85 mm in diameter. The rocket wrench is supplied with a carrying case.

Status
In production.

Contractor
MELTRON International Security Services GmbH.

MEL 271 Rocket Wrench (MELTRON International Security Services)
1298746

Components of MEL 271 (MELTRON International Security Services)
1298747

MEL 300-A EOD/IEDD Marking Set

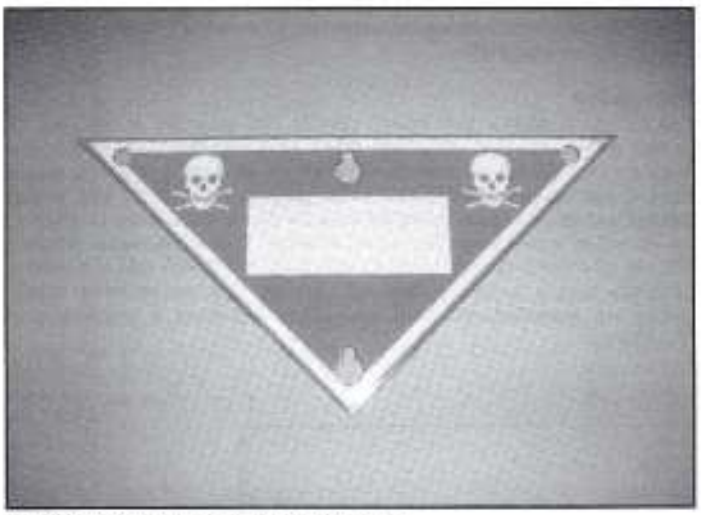
Development
The MEL 300-A EOD/IEDD Marking Set was developed for the German Federal Armed Forces.

Description
The Marking Set consists of marking stake, marking plate, luminous red/white band, spray box colour marking, mallet, writing pad, wax pin and transportation bag.

Specifications
Weight: approx 4 kg
Height: 150 mm
Length: 950 mm
Width: 250 mm
NATO stock number: 9905-12-389-1047

Status
In production.

Contractor
MELTRON International Security Services GmbH.



MEL 300-A marking plate for marking set
(MELTRON International Security Services) 1298754

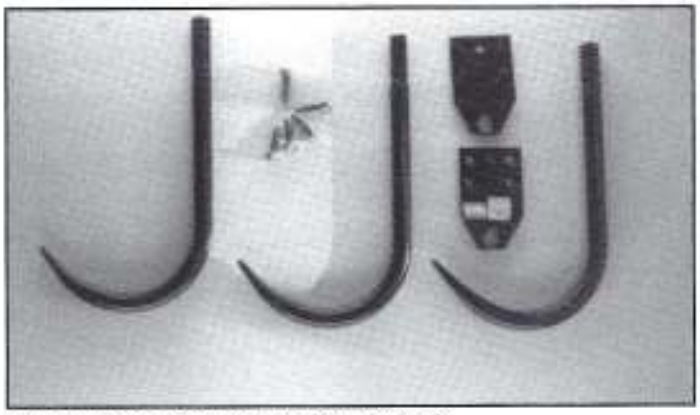
MEL 300-K19 minehook

Development
The MEL 300-K19 minehook was developed for remotely pulling mines.

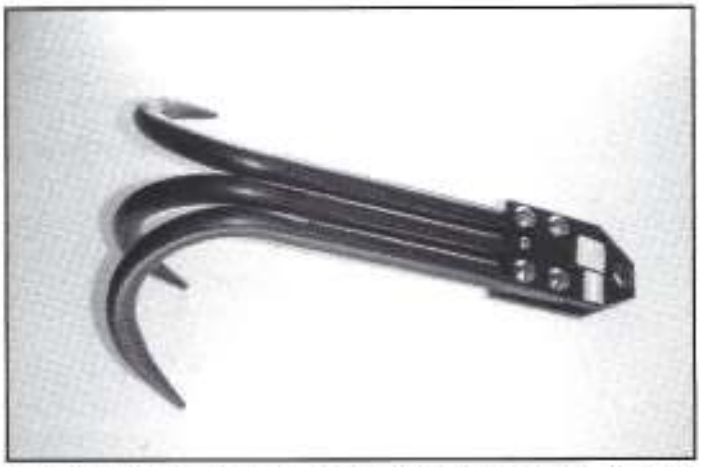
Description
The configuration of the minehook can be changed to suit different mines.

Status
In production.

Contractor
MELTRON International Security Services GmbH.



Individual parts of the MEL 300-K19 minehook
(MELTRON International Security Services) 1298741



MEL 300-K19 minehook (MELTRON International Security Services)
1298740

MEL 320 EOD Tool Set

Description
The MEL 320 EOD tool set can be used in various applications including: manual disarming by disassembling and removing components and assemblies of explosive ordnance, exposing ordnance, illuminating work on ordnance, preparing ordnance for further EOD procedures and opening of packages and crates. The tool set can be used with MEL 330 and MEL 244 (see separate entries).

Specifications
NATO stock number: 1385-12-364-7530

Status
In production.

Contractor
MELTRON International Security Systems GmbH.

MEL 320 EOD Tool Set
(MELTRON International Security Services)
1298742

MEL 330 IEDD Tool Set

Development
The MEL 330 IEDD Tool Set is designed for manual dismantling of IEDs.

Description
The tool set can be used to open containers of diverse materials. All of the equipment can be used independently of a power supply. The file tools allow precise work to be carried out in confined spaces.

Specifications
NATO stock number: 1385-12364-7531

Status
In production.

Contractor
MELTRON International Security Services GmbH.

MEL 330 IEDD Tool Set
(MELTRON International Security Services)
1298743

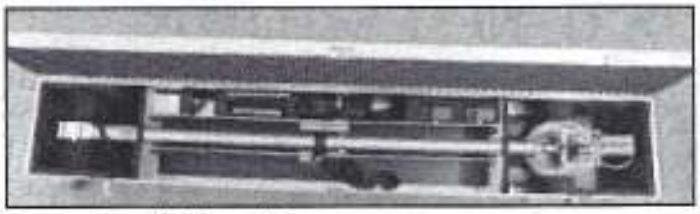
MEL 1018 & MEL 1019 Telescopic Manipulator

Description
Two versions of the telescopic manipulator are available, the MEL 1018 and MEL 1019. The MEL 1018 is a manipulator with electrical telescopic function and has a working distance of 3 m. The MEL 1019 is a manipulator with manual telescopic function and has a working distance of 4 m. Both come supplied with Li-ion battery with fuel gauge control, battery charger, counterweight system and flight case. Also available as an option are a wheeled tripod and video kit which contains camera, head display and portable DVR.

Specifications
NATO stock number: 6665-12-359-7629

Status
In production.

Contractor
MELTRON International Security Services GmbH.



Transport box of MEL manipulator
(MELTRON International Security Services) 1298758

MEL 1018 & 1019 Telescopic Manipulator (electrical/manual)
1298757

Mini MACE

Description
ANT's mini MACE (MACE being Mobile Abrasive Cutting Equipment) is the first all-in-one Water Abrasive Suspension (WAS) cutting unit designed specifically for remote-control operations and is in use successfully around the world, notably in Australia, Germany, Slovakia, UK and US.

Using this hands-free WAS system, high-risk operations can be safely conducted with remotely-operated vehicles (ROVs) or cutting tables. The mini MACE system can be adapted for use with nearly all the ROVs which are currently used in the EOD/improvised explosive device disposal market. The unit is either installed on the back of the ROV or is drawn on a special trailer. The cuts can also be guided by manipulation systems such as cutting tables without the use of ROVs.

The High Pressure Pump (HPP) supplies pressurised water from the tank through a connection hose to the Abrasive Mixing Unit (AMU) at a maximum pressure of 450 bar. The inlet water is directed through the AMU circuit and allows abrasive to be fed into the exiting water stream from the unit. This is fed along a hose to the nozzle holder and nozzle. The pressure energy is changed as the abrasive stream exits the nozzle into a high velocity jet which is capable of cutting through most objects. The configuration of the jetstream causes minimal temperature rise and there is no physical contact with the target object.

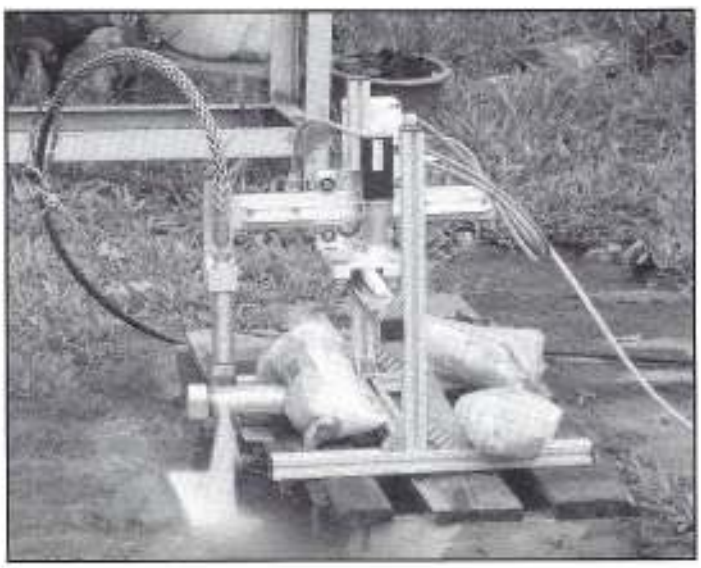
The configuration presented is lightweight, self-supporting and allows evidence preservation.

Specifications
Max pressure: 450 bar (6525 PSI)
Operation pressure valves: servo electric, remote control (optional)
Weight: 100 kg (220.5 lb) empty
Length: 720 mm (without hopper)
Width: 600 mm (without hopper)
Height: 700 mm (without hopper)
Water tank: 25 l (6.61 US gallon) net

Status
Available.

Contractor
ANT Applied New Technologies AG.

ROV with mini MACE on trailer cutting a large vehicle bomb (ANT AG)
1041132



Cutting a pipe bomb with mini MACE and 2-axis cutting table
(ANT AG)
1041133

Mobile Abrasive Cutting Equipment MACE

Description

MACE is a portable, multicomponent Water Abrasive Suspension (WAS) jet cutting unit for rendering safe unexploded ordnance on land and underwater. The abrasive mixing unit is coupled with a High Pressure Pump (HPP) and a manipulation system developed for use in EOD and demilitarisation.

The separate HPP unit has its own water header tank which is supplied with water from a separate source. The HPP supplies pressurised water through a connection hose to the Abrasive Mixing Unit (AMU) at a maximum pressure of 700 bar and the pressure can be manually adjusted. The inlet water is directed through the AMU circuit and allows abrasive to be fed into the exiting water stream from the unit at a predetermined rate of flow. This is fed under high pressure but low velocity along a hose to the nozzle holder and nozzle. The pressure energy is changed as the abrasive stream exits the nozzle into a high velocity jet which is capable of cutting through most objects. The configuration of the jetstream causes minimal temperature rise and there is no physical contact with the target object.

The nozzle can be remotely operated, the control point being as much as 500 m from the cutting point. Manipulation of the nozzle may be hydraulically or electrically controlled. In the latter case, electrical power is supplied by the system's own portable generator. The most advanced and current system is a lightweight 3-axis cutting table capable of being deployed in any attitude.

WAS cutting systems are currently used by special forces in Australia, France, Germany, Japan, Netherlands, Slovakia, Sweden, UK and US.

Specifications

AMU 700-12
Abrasive Mixing Unit
Max working pressure: 700 bar (10150 PSI)
Weight: 115 kg (253.58 lb) empty
Length: 725 mm
Width: 500 mm
Height: 780 mm
Operation parameter
Max working pressure: 700 bar (10150 PSI)
Water flow: 6 l/min
Cutting time with one filling: 25 min
Cutting performance (in air):

10 mm steel	115 mm/min
25 mm steel	46 mm/min
50 mm steel	21 mm/min

Generator
Power: 2 kW, 230 V/50 Hz
Weight: 55 kg (121.28 lb)
Length: 536 mm (in steel frame)
Width: 400 mm (in steel frame)
Height: 458 mm (in steel frame)

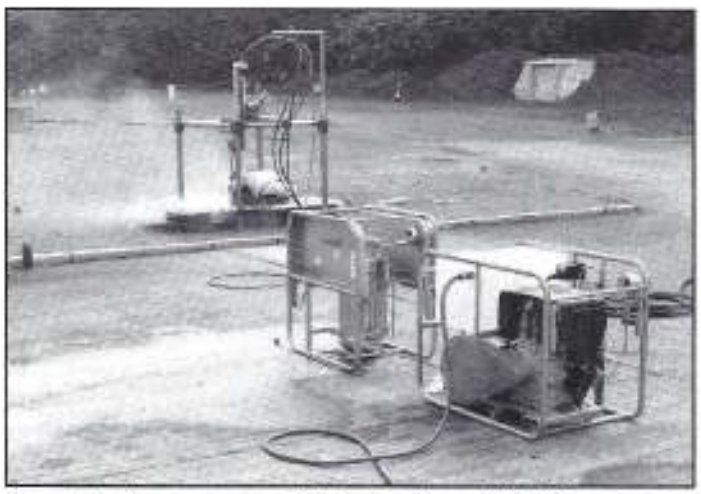
Status

In production and in service.

Contractor

ANT Applied New Technologies AG.

MACE cutting a bomb (ANT AG) 1041130



The mobile three-component MACE system in use (ANT AG) 1041131

NOMATOOLS anti-magnetic tools

Description

telerob's NOMATOOLS can be used for dismantling explosive devices, as well as such tasks as varied as assembling magnetic resonance scanners and building submarines. They are extremely permeable and durable and are not made from beryllium so are completely safe.

With an HRC level of up to 48, they are exceptionally hard-wearing, corrosion-free and acid resistant.

Specifications

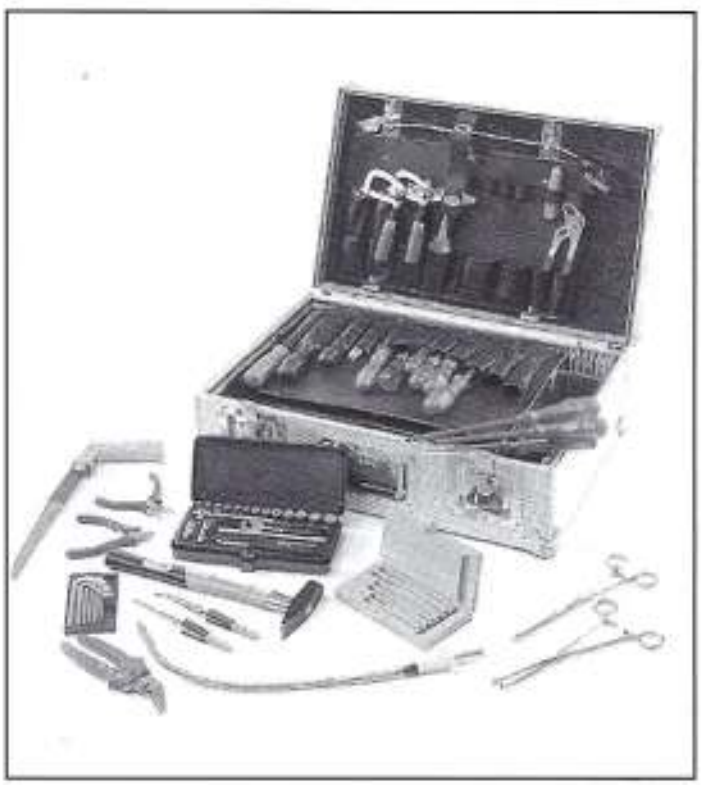
Max permeability: 1.05 at 80 A/cm

Status

Available.

Contractor

telerob Gesellschaft für Fernhantierungstechnik mbH.



telerob's TEL250 B non-magnetic IEDD tool kit (telerob) 0077645

PHYRRUS hook and line set

Description
The PHYRRUS hook and line set has been designed to be an important tool for police and military bomb disposal teams for use in EOD, explosive ordnance reconnaissance, and improvised explosive device search and disposal operations.

PHYRRUS comprises a range of tools including two 100 m coloured low stretch lines, hooks, fixed and self-opening snatch blocks and telescopic arms. For ease of operation and access, all parts are attached by quick release mechanisms to a specially designed carrying panel. The set can be handled and used while wearing full personal protection equipment.

Specifications
Overall dimensions incl reel and doorway anchors
- length: 1.28 m
- height: 0.49 m
- width: 0.32 m

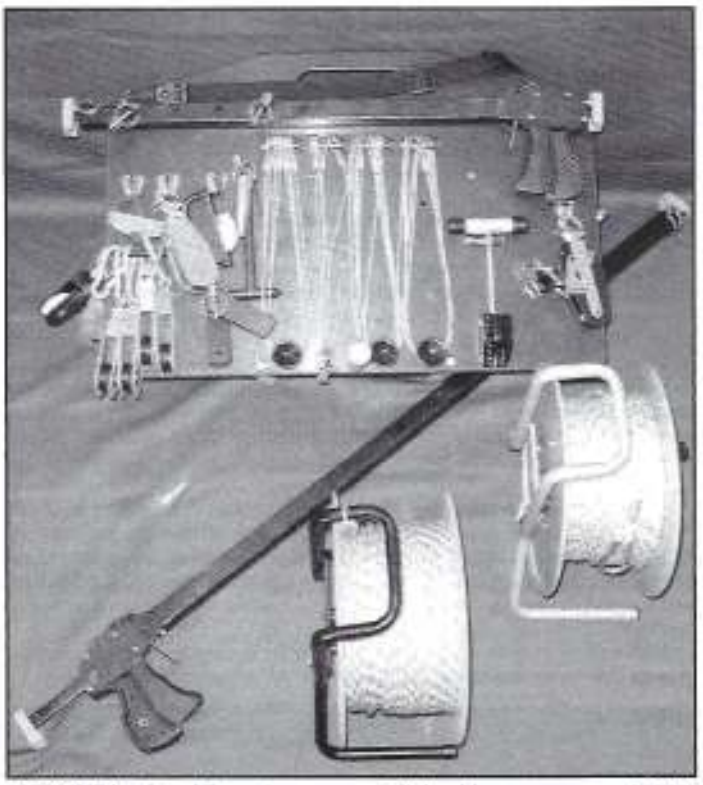
Tool board dimensions
- length: 0.7 m
- height: 0.49 m

Telescopic arm length: max 2.9 m
Adjustable doorway anchor
- short: 0.7–1.16 m
- long: 1.21–2.06 m

Weight of complete set: 22.5 kg

Status
In production. In service with serveral military and police EOD/IEDD teams worldwide.

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.



PHYRRUS hook and line set components (telerob) 0120999

Special hook and line kit in backpack

Development
This hook and line kit from Force Ware is intended for use by special forces.

Description
The set comes in a rigid backpack and includes: main and secondary line, reel, hooks, eyes, O-rings, lightweight spring grips, mole grip, self-adhesive anchor pads, suction pads, shock cord, self-locking forceps, rope and wire slings in a range of sizes, shackles, karabiners, pitons, clamps, doorstops, stainless steel extension rod, hooks with spring-loaded gates, hook holder and mounts, pulley with jammer cleat, self-relieving snatch block, splitter ball, snatch block, tactical search mirror, manual entry kit, multifunction pocket tool kit and LED head torch.

Status
In production.

Contractor
Force Ware GmbH.

The special forces hook and line kit (Force Ware) 1041281

TEL219 tripod

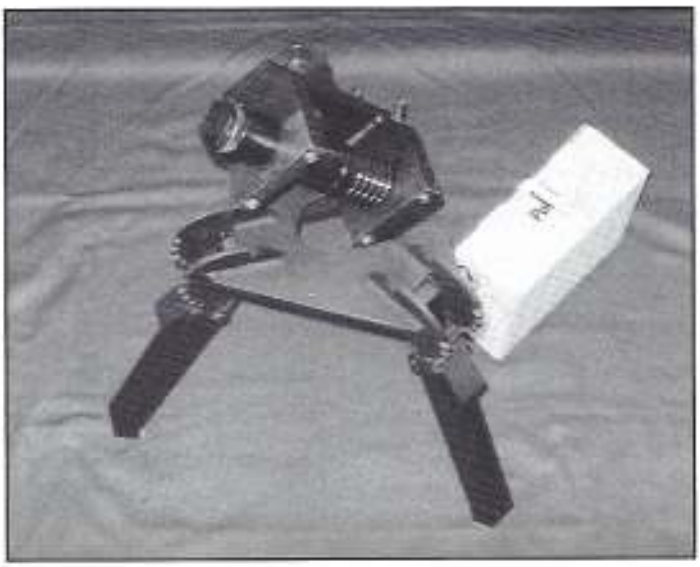
Description
The TEL219 is a height-adjustable tripod used with the TEL220 disruptor (see separate entry). It allows firing angles ranging from 0° (horizontal firing) to 90°.

Specifications
Dimensions, deployed (disruptor not included)
- height: 55 cm
- width: 30 cm

Weight, deployed: 11 kg

Status
Available and in service.

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.



TEL219 tripod (telerob) 0077648

TEL242, Tel242A and TEL242B hook and line sets

Description

The TEL242 36-part hook and line set is designed to enable the operator to dispose of, open, tear or otherwise manipulate objects from a safe distance. The components are stored in a rigid metal case with receiver for cable drum or auxiliary rope. The reel can be fixed to the case to provide an anchor base or counterbalance.

The TEL242A is a 77-part hook and line set that comes packed in two sturdy transport cases, which also have a built-in receiver for cable drum or auxiliary rope. As with the TEL242, the entire unit can act as an anchor point or counterweight.

The TEL242B is a 23-part hood and line set designed for manipulating especially heavy objects. It also comes in a transport case with built-in receiver.

Specifications

Dimensions, when packed, TEL242
length: 97 cm
width: 45 cm
height: 16 cm
Weight of complete set: 15 kg
Dimensions, when packed, TEL242A
length: 97 cm
width: 45 cm
height: 16 cm
Weight of complete set, per case: 16 kg
Dimensions, when packed, TEL242B
length: 97 cm
width: 45 cm
height: 16 cm
Weight of complete set: 25 kg

TEL242 hook and line set components (telerob) 0077644

Status

Available.

Contractor

telerob Gesellschaft für Fernhantierungstechnik mbH.

VANGUARD marking and cordoning equipment

Description

VANGUARD comprises equipment to mark and cordon dangerous areas such as minefields, contaminated ground and safety zones around suspicious objects. Standardised signs, sticks, tools, coloured illumination along with additional accessories enable the equipment to be used in a wide range of scenarios.

Specifications

Dimensions
length: 0.65 m
width: 0.5 m
height: 0.25 m
weight: approx 30 kg

Status

In production. In service with several military and police EOD/IEDD teams worldwide.

Contractor

telerob Gesellschaft für Fernhantierungstechnik mbH.

Switzerland

Swiss Tool with explosive cap crimper

Description

Manufactured by Victorinox, the Swiss Tool is available in an EOD version with a black-oxidised finish and explosive cap crimper. The tool has the following features: pliers, 2 mm screwdriver, 3 mm screwdriver, wire cutter, cap crimper, cap lifter, 7.5 mm screwdriver, larger blade, serrated blade, metal file, metal saw, wood saw, reamer/punch, Phillips screwdriver (small and larger screws), chisel/scraper, wire bender, wire stripper, wire scraper, can opener, 230 mm ruler, 9 in ruler and electrical crimper.

The Swiss Tool is supplied in a nylon belt pouch and has a lifetime guarantee.

Specifications

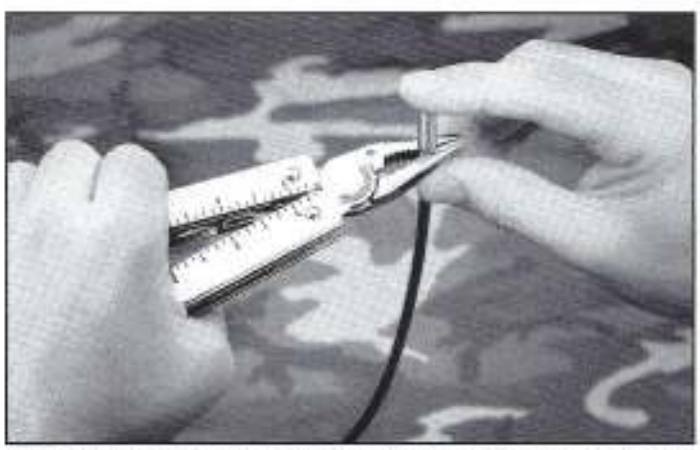
Length:
open: 170 mm
closed: 115 mm
Weight: 280 g

Status

In production.

Contractor

Victorinox.



The EOD version of the Swiss Tool has an explosive cap crimper (Victorinox) 0074859

The EOD version of the Swiss Tool has an explosive cap crimper (Victorinox) 0074858

United Kingdom

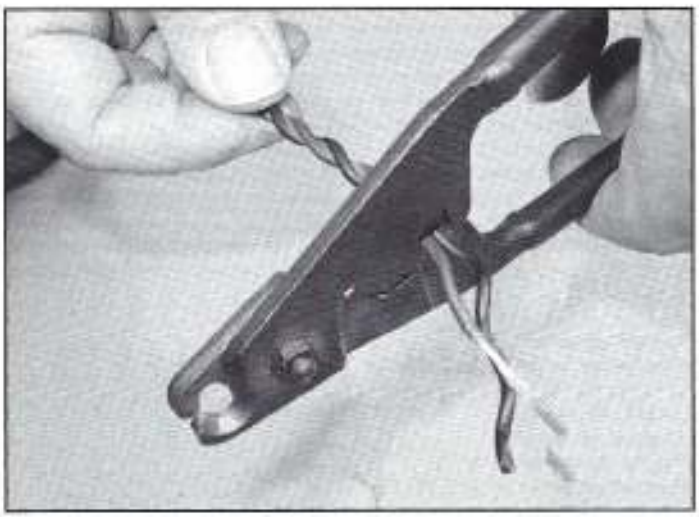
ABL 022 detonator crimping tool

Description
The ABL 022 Crimper is a hand-held tool used to crimp detonators to a safety fuse. It is capable of single-handed operation by either right or left-handed personnel. The ABL 022 is corrosion-resistant and incorporates a wire stripper and cutter, and a screwdriver blade.

The crimp produced will withstand a pull-off force of 75 N and does not impair the integrity of either the safety fuse or the detonator.

Status
In production and in service with the UK MoD and worldwide.

Contractor
AB Precision (Poole) Limited.



EOD crimping tool cutting through wire (AB Precision)
1299212

AWCS

Development
The AWCS abrasive waterjet cutting system was developed to enable an operator to carry out decommissioning operations on sensitive munitions in a safe and controlled manner whilst operating from a safe distance.

Description
The AWCS is accurate to within 0.002 m. It uses cold cutting techniques with an inert abrasive compound, generates no heat and as such can be used in flammable or explosive environments. The system exerts a very low force or vibration onto the target being cut so is ideal for cutting operation with least risk of disturbance to the target. The AWCS can be deployed rapidly from any available vehicle such as a large van or small truck. If required, an optional Load Bed Base Pallet can be deployed with a forklift truck, crane or helicopter. The AWCS can operate in hot/cold weather climates and conditions up to 3 m of seawater.

Specifications
Operating pressure: 690 bar
Flow rate: 5 litres/min
Engine: 6 kW diesel engine
Operating temperature: 0 to +53°C (standard)
−10 to 0°C (using saturated saline solution)

Status
In service with the UK MoD.

Contractor
AB Precision (Poole) Ltd.

Endoscope and mirror kits

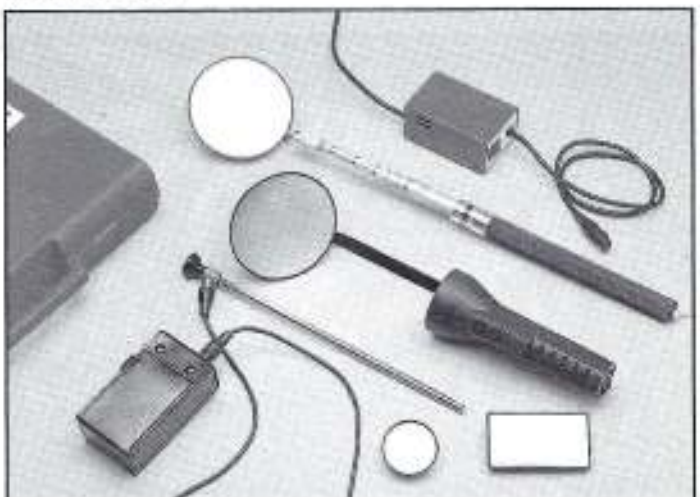
Description
Allen-Vanguard produces two portable search kits suitable for searching inaccessible areas of buildings, ships and vehicles.

The basic kit comprises endoscope, battery pack, battery charger and spare lamp. The larger kit also includes telescopic arm, mirror arm with torch, two convex mirrors, small flat mirror and rectangular mirror. Each kit is supplied in a tough plastic carrying case which features a protective foam lining.

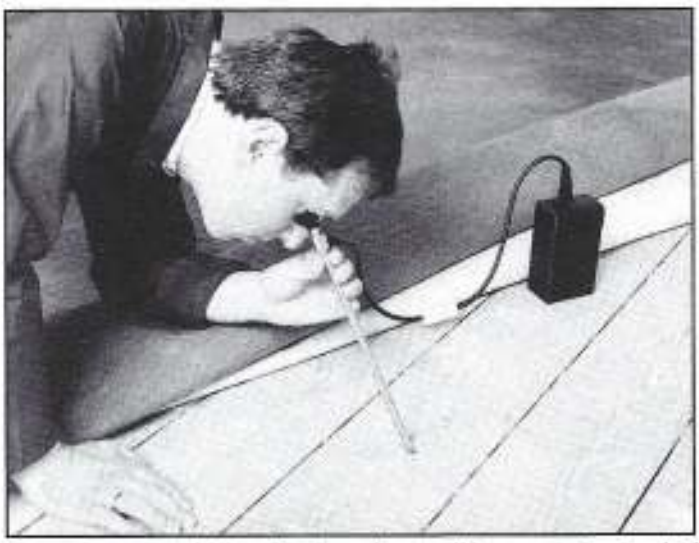
The endoscope is a portable side viewing endoscope for searching inaccessible areas through holes and gaps of 10 mm diameter. A bright 10 W halogen lamp in the tip of the endoscope enables inspections to be made over distances of up to 1.5 m. Power is supplied from a rechargeable battery providing 2 hours of continuous use when fully charged.

The long reach telescopic mirror extends to 1,400 mm and closes to 350 mm for storage. Mirrors include a 140 mm diameter convex mirror to provide a wide field of view and a smaller 64 mm diameter mirror for use in confined spaces.

Specifications
Endoscope
diameter: 9.65 mm
length: 350 mm
field of view: 30°
Battery pack: 3 Ah 6 V lead/acid
Battery pack weight: 1.2 kg
Battery charger: 6 V, 110 V or 230 V AC input
Telescopic arm
length extended: 1,400 mm
length closed: 350 mm
mount: adjustable ball and socket
weight: 519 g
Mirror arm with torch
length: 470 mm
mount: 45° fixed
power supply: 2 D cell



Allen-Vanguard endoscope and mirror kits (Allen Vanguard) 0074285



The endoscope and mirror kit allows inaccessible areas to be searched (Allen-Vanguard) 0074286

Mirrors

Size	Type
140 mm diameter	glass, convex
64 mm diameter	glass, flat
64 × 114 mm	glass, flat

Status
In production and in service.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

EOD/TSCM flexible endoscope search kit

Development
The EOD/TSCM flexible endoscope search kit is designed for use with law enforcement, customs officers, bomb technicians and technical surveillance countermeasure search teams.

Description
This piece of equipment is a portable visual search kit, incorporating high resolution glass fibre image guides with light transmission. Level controls allow single-handed operation of 2 way tip articulation. The robe can be articulated to a specific position and then locked. The endoscope is flexible with a focusing eye-piece. The outer covering is made from tungsten braids sheathing which is water and petrol resistant.

Specifications
Diameter: 6 mm (3, 4 and 8 mm optional*)
Length: 1,000 mm
Tip deflection: 2 way
Forward viewing: 0°
Field of view: 60°
Battery: NiCad battery pack 12 V 5 Ah
Light source: 12 V 75 W Halogen lamp, iris intensity control
Operating time: 1 h (with Halogen lamp)

EOD/TSCM optical fibre search kit (flexible endoscope)
(Winkelmann (UK) Ltd) 1298767

*special versions with UV illumination fibres are available, these use detachable liquid light guides.

Status
In production.

Contractor
Winkelmann (UK) Ltd.

EOD/TSCM rigid endoscope visual search kit

Development
The EOD/TSCM rigid endoscope visual search kit was designed to aid law enforcement, customs officers, bomb technicians and technical surveillance countermeasure search teams.

Description
The kit comprises a rigid endoscope with rotational scanning (340°) and focusing eyepiece. The set is housed in a foam-lined case. Options include: spare lamp, Watec colour camera, hand-held monitor, TV adapter and 120° angled eyepiece adapter.

Specifications
Diameter: 8 mm
(2.8, 4, 5.8, 10, 12 and 15 mm optional)
Length: 636 mm
Tip deflection: 2 way
Field-of-view: 100°
Battery: NiCad battery pack 12 V 5 Ah
Light source: 12 V 75 W Halogen lamp, iris intensity control
Operating time: 1 h (with Halogen lamp)

Status
In production.

Contractor
Winkelmann (UK) Ltd.

EOD/TSCM rigid endoscope visual search kit
(Winkelmann (UK) Ltd)
1298766

HAL® BombTec™ kit

Description
The HAL® BombTec™ combines multiple access and disposal capabilities into a single, comprehensive 2-line rigging kit for gaining access to and dealing with devices. The equipment can be deployed in a wide range of scenarios involving buildings, vehicles (road, water and air) and urban/rural locations.

The portable BombTec™ kit includes components for attaching lines, anchoring pulleys and manoeuvring objects. Break-away pulleys are used to change the line direction, to give lift, avoid obstacles and allow operation from behind cover. The lines are colour-coded to minimise confusion and facilitate advanced techniques.

The kit contains: two reels; two lines (120 m); pulling handle; EOD sledge; three sizes of hook; double hooks; rings; 'O' rings; lightweight

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jeod.janes.com

The HAL® BombTec™ in use (Allen-Vanguard) 1154151

The HAL® BombTec™ kit (Allen-Vanguard) 1041268

spring grips; vice jaw grip; self-adhesive anchor pads; double pad suction anchor; three sizes of rope sling; three sizes of wire sling; belt sling; 'D' shaped shackle; four sizes of piton; two sizes of gate Karabiners; Allen-Vanguard grips; seizers; doorway anchors; sliding clamp anchor; screw eyes; rubber door wedges; three function door stops; telescopic pole and hook assembly; self-opening snatch blocks; splitter balls; one-way lock snatch block; snatch blocks; line branch; pocket search mirror and multi-function tool. The BombTec™ kit is housed in a transport case.

Status
In production and in service.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

HAL® Building Accessory Kit (BAK)

Description
The HAL® Building Accessory Kit is a matched partner to the HAL® Vehicle Access Kit. It also functions as a complementary kit with the HAL® BT1/00 and HAL® BT2/00 rigging kits. The HAL® Building Accessory Kit is a Level 2 standard accessory kit and an equally important part of the overall HAL® BombTec™ Rigging System.

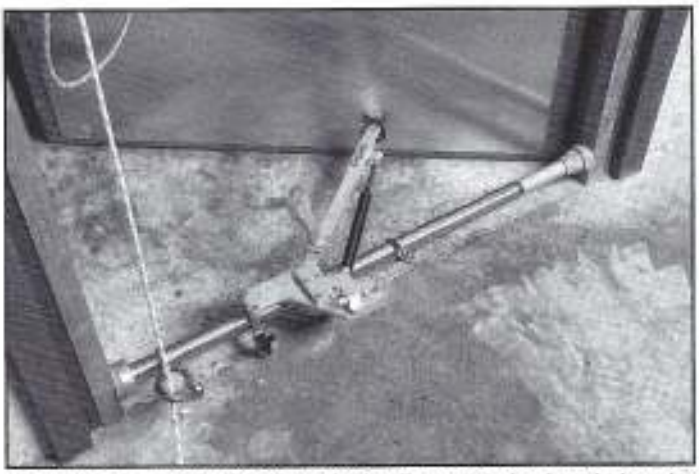
Dealing successfully with an IEDO or other tactical task in a building will often require the use of specially designed rigging equipment. The HAL® Building Accessory Kit contains a range of special tools for use when opening building doors remotely in order to gain access and for providing anchor points for lines and pulleys.

All items in the kit are simple to understand, straightforward to deploy and quick to operate, thus minimising the time that the bomb technician remains at risk from a suspect device.

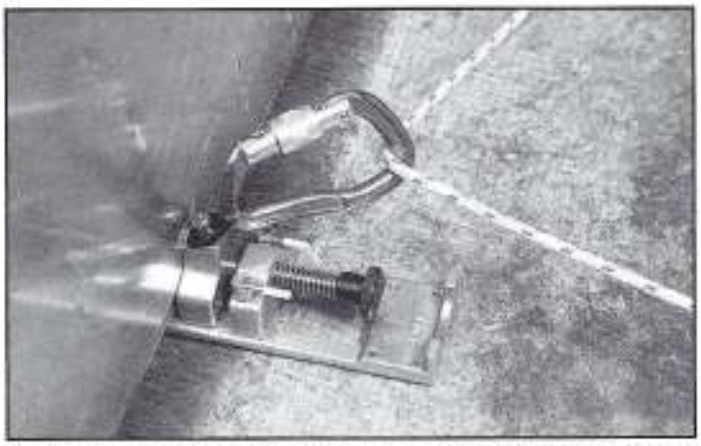
Status
Available.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

HAL® BAK components (Allen-Vanguard) 1154162



The centrepiece of the HAL83 is a hydraulic-arm mechanism designed to open doors swiftly and effectively (Allen-Vanguard) 1154164

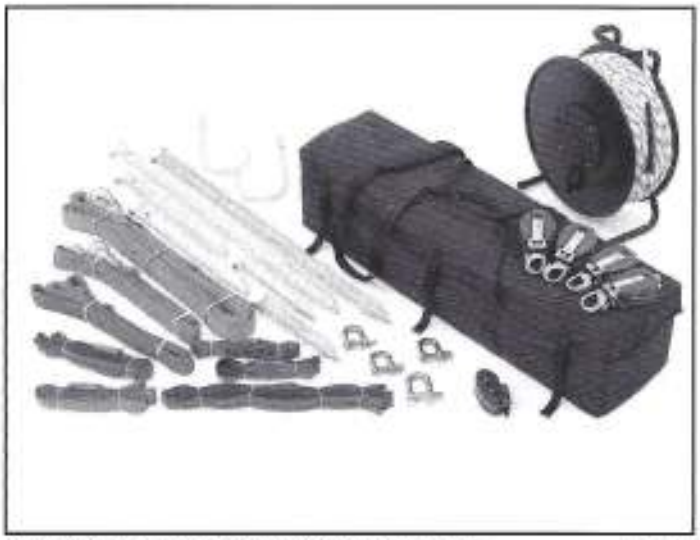


Placed under a closed door, the Building Under Door Anchor tool (HAL84) clamps to both sides of the door to provide a secure and effective anchor point at floor level (Allen-Vanguard) 1154163

HAL® Heavy Duty Kit (Mk 3) hook and line

Description
The HAL® Mk 3 is a heavy duty hook and line kit approved by the UK Ministry of Defence (MoD) for moving vehicles and heavy improvised explosive devices (IEDs) and Explosive Ordnance Disposal (EOD). It has been designed for use where the load limitations of the HAL® Mk 1 and Mk 2 are likely to be exceeded.

Components in the HAL® Mk 3, which include slings, hooks and shackles, enable the 150 m low stretch line to be attached to a suspect vehicle, large UXO or container quickly and securely with the minimum of disturbance. Snatch blocks allow the operator to change the direction



The HAL® Heavy Duty Kit (Mk 3) (Allen-Vanguard) 1154155

The HAL® Heavy Duty Kit (Mk 3) is approved by the UK Ministry of Defence for moving vehicles and heavy IEDs (Allen-Vanguard) 1154156

of the line to gain protection, or to operate in confined areas. Ground anchors enable the snatch blocks to be used where there are no natural anchorage points.

The kit is supplied in a reinforced canvas case, with separate reel and line.

Specifications

Line
- length: 150 m
- diameter: 10 mm
- strength: 3,670 kg

Weight
- case and accessories: 25 kg
- reel and line: 21 kg

Status

In production and in service.

Contractor

Allen-Vanguard (formerly PW Allen & Company Limited).

HAL® Mk 1 hook and line kit

Description

The HAL® Mk 1 was designed as a basic hook and line kit recommended for clearing explosive ordnance and was developed in conjunction with British Army bomb disposal teams to provide a versatile means of remotely moving dangerous objects in a wide variety of locations. The HAL® Mk 1 was deployed on active service in many areas of the world. It became standard issue for many EOD teams and its use has been taught on EOD training courses in the UK and US.

The varied components enable a line to be securely fastened to all types of munitions and improvised explosive devices to facilitate their movement to improve access for many types of disposal operation.

Alternatively the kit is often used as a means of 'tumbling' suspect objects when carrying out high risk searches of hides or 'safe houses' which may be booby-trapped.

Main line: the main line is constructed with a nylon outer sheath and a Kevlar® core to ensure that the overall stretch is less than 1 per cent when the line is fully extended. The main line is terminated with a spring gaited 'snap' hook for quick connection to a wide range of hooks.

Hooks: 12.5, 25 and 50 mm diameter hooks are supplied with both plain and barbed points for attaching the line securely to soft materials such as holdalls or fertiliser sacks. All hooks are constructed of non-ferritic stainless steel.

Snatch blocks: these have a side opening cheek that allows the line to be loaded or removed from the block without having to detach the line from the object being moved. Snatch blocks can also be used to change the direction of the line or to achieve mechanical advantage.

Case and reel: the reel is anchored to the case housing the accessories and is fitted with a locking brake to prevent excessive line run out. The case is fitted with a number of anchor points with which to tie off the main line, or to anchor the case itself to a tree or post. Both the case and reel are constructed in heavy gauge steel for long service and durability.

Specifications

Line
- length: 100 m
- diameter: 5.5 mm
- strength: 750 kg

Case dimensions: 115 × 510 × 255 mm

Status

No longer in production.

Contractor

Allen-Vanguard (formerly PW Allen & Company Limited).

HAL® Mk 1 kit (Allen-Vanguard) 0528216

The hook and line set provides a versatile means of moving suspicious objects (Allen-Vanguard) 0074275

HAL® Mk 2 hook and line kit

Description

The HAL® Mk 2 hook and line kit was designed as a 70-piece, two-line Explosive Ordnance Disposal (EOD)/improvised explosive device (IED) disposal rigging kit optimised for dealing with IEDs in vehicles. The kit contains hooks, rope and wire slings, pitons, seizers, crocodile grips, vice jaw grips, suction pad anchors, shock cords and snatch blocks. Two 120 m colour coded lines are included allowing complex operations to be carried out.

The HAL® Mk 2 kit has a wide range of components for dealing with IEDs in vehicles (Allen-Vanguard) 0074278

The kit provides a variety of components for assisting entry to vehicles as well as for dragging and removing suspect packages and interior fittings. Hooks and grippers can be used for opening doors and glove compartments. Grippers, hooks and seizers can be used to attach a line to clothing, packages and seats.

The kit was supplied in a metal case with separate reels.

Specifications

Line

length: 120 m
diameter: 5.5 mm
strength: 750 kg
colours: white and black/red

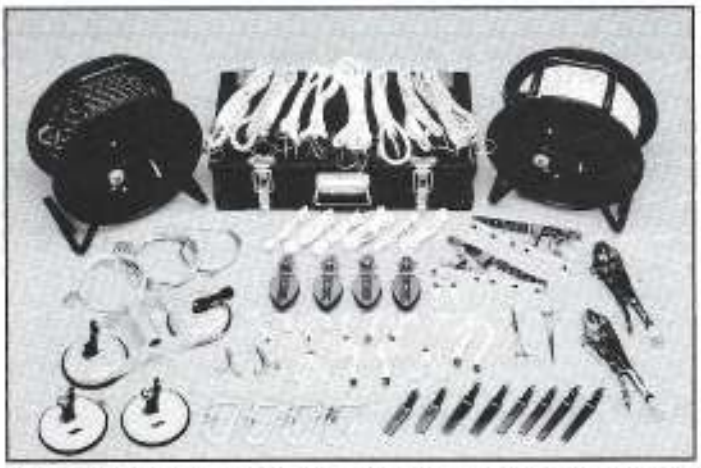
Case dimensions: 980 × 370 × 120 mm

Status

No longer in production.

Contractor

Allen-Vanguard (formerly PW Allen & Company Limited).



The HAL® Mk 2 kit has a wide range of components for dealing with IEDs in vehicles (Allen-Vanguard) 0528217

HAL® Mk 4 hook and line kit

Description

The HAL® Mk 4 hook and line kit is a 80-piece EOD/Improvised Explosive Devise (IED) disposal rigging kit optimised for dealing with IEDs in buildings. It has a variety of components for attaching a line to a suspected IED and devices for anchoring snatch blocks to floors, walls and window and door frames. Snatch blocks are self-opening to enable IEDs to be manoeuvred along complex routes in a single operation. The 120 m line enables the removal operation to be conducted remotely.

The HAL® Mk 4 hook and line kit (Allen Vanguard) 0074282

The kit includes a low stretch line ready-wound on to a reel, pulling handle, line branch, hooks, grips, rope and wire slings, karabiners, shackles, pitons, a screw eye, a range of anchors and a compact pocket knife style tool set. Also included is a sledge which can be used to improve manoeuvrability of a suspected object on stairs or rough ground and to prevent snagging at corners. A telescopic pole which extends to 3 m may be used to attach a hook and line remotely.

All components fit into a compact cordura carry case and can easily be carried by one man, while leaving one hand free. Individual components are also available separately.

HAL® Mk 4 kit components (Allen-Vanguard) 0074281

Specifications
Line
length: 120 m
diameter: 5.5 mm
strength: 750 kg
Case dimensions: 980 × 370 × 120 mm

Status
No longer in production.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

The HAL® Mk 4 kit provides components for remotely attaching a line to a suspected IED and devices for anchoring snatch blocks to floors, walls and window door frames (Allen-Vanguard)
0074283

HAL® Special Operations kit

Description
The HAL® Special Operations kit is a lightweight and highly portable rigging kit for gaining access to and dealing with hazardous devices in tactical situations. It is designed for EOD/Improvised Explosive Device Disposal (IEDD) tasks where speedy and straightforward deployment of equipment is a critical success factor – such as in locations where physical access is restricted, battlefield/combat zone tasks and peacekeeping or post-conflict operations.

The kit is housed in a custom-designed backpack that provides dedicated stowage for the comprehensive rigging kit as well as other essential EOD/IEDD items such as a disruptor with firing cable and exploder. The pockets inside the main compartment can be reconfigured by the user to reflect individual requirements. Mesh fronts on each pocket allow easy recognition and swift access to all items. Up to 100 m of high-strength, low-stretch line is carried in a detachable pocket attached to the side of the backpack. Other features include external pockets for a telescopic mirror and a small manual entry tool kit.

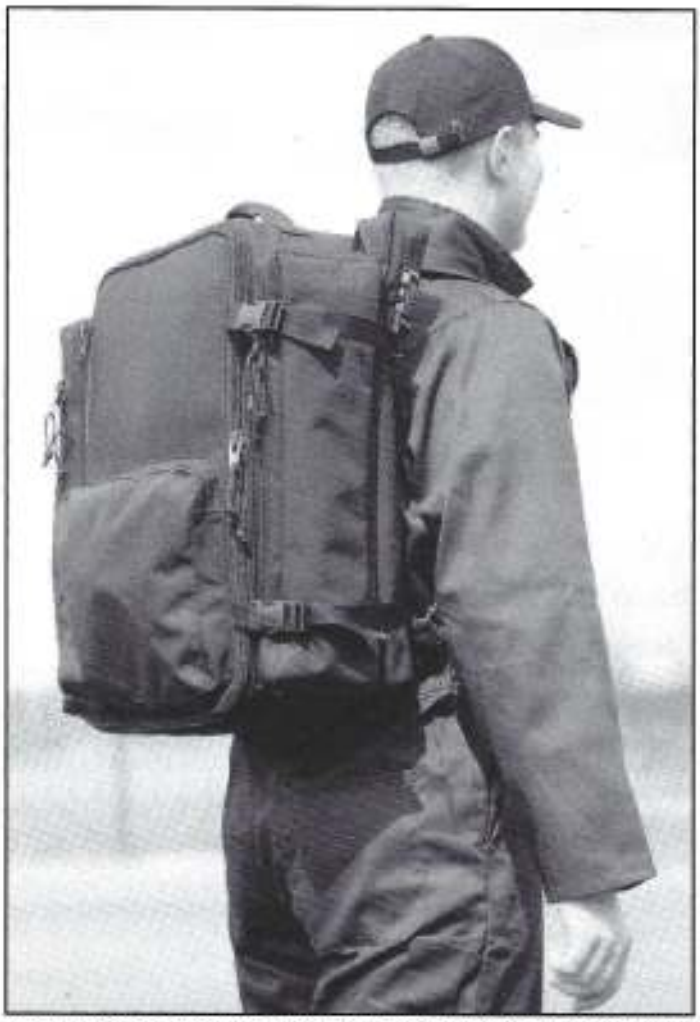
The HAL® Special Operations kit is an open backpack (Allen-Vanguard)
1154144

The HAL® Special Operations backpack contains a comprehensive rigging kit (Allen-Vanguard)
1154145

Specifications
Maximum overall weight (standard kit): 13 kg

Status
In production and in service.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).



The HAL® Special Operations kit is housed in a backpack enabling the equipment to be deployed quickly (Allen-Vanguard)
0628226

HAL® TRI 2/00 lightweight tripod

Description

The HAL® TRI 2/00 portable tripod is used to provide lift during EOD, including improvised explosive device disposal (IEDD) rigging tasks. Developed specifically to lift smaller objects (up to 90 kg) in the IEDD role, this lightweight tripod integrates with the Allen-Vanguard range of hook and line kits (see separate entries).

The tripod is easily rigged and placed by a single bomb technician in full PPE and can be used in any intermediate leg position. Self-levelling feet and anchor attachments increase the versatility and range of potential applications. The legs are manufactured from carbon-fibre to provide strength and to keep weight to a minimum. Snatch blocks and pulleys are provided to allow the line to be rigged to mechanical advantage while an auxiliary pulley ensures that the pulling force is applied at ground level for maximum stability. A purpose-built reinforced semi-rigid nylon transport case completes the kit.

Specifications

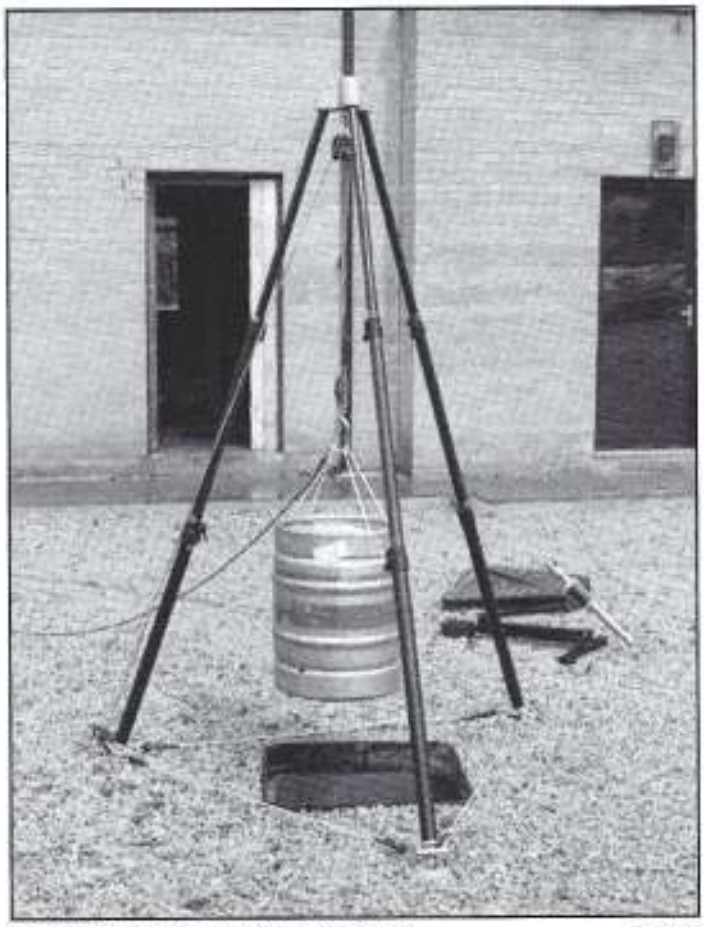
Load capacity (maximum recommended): 90 kg
Maximum extended height: 2.15 m
Height closed: 1.015 m
Working height
under top eye: 2.015 m
under snatch block: 1.88 m
Weight
tripod: 7.0 kg
total kit inc. case: 12.7 kg
Pitch circle diameter: 1.6 m
Foot diameter: 100 mm
Anchor pin length: 275 mm
Load capacity
main block: 1,350 kg
auxiliary pulley: 400 kg
Case dimensions: 1,050 × 260 × 205 mm

Status

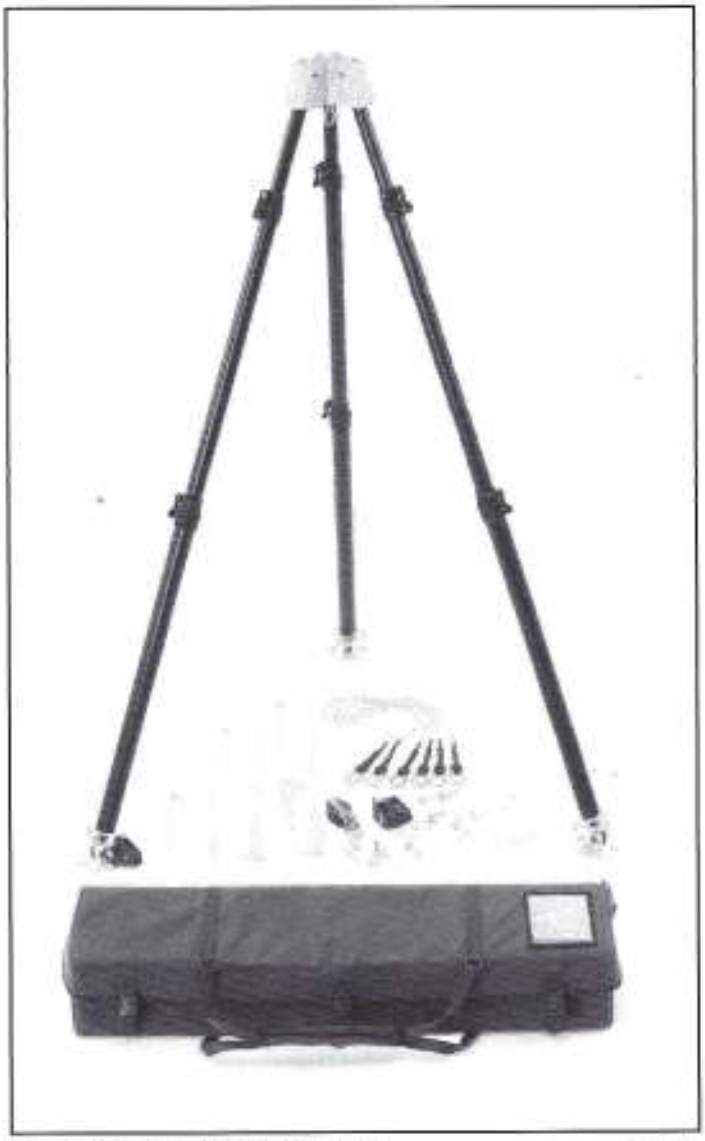
In production and in service.

Contractor

Allen-Vanguard (formerly PW Allen & Company Limited).



The TRI 2/00 tripod in use (Allen-Vanguard) 1154157



The TRI 2/00 tripod kit (Allen-Vanguard) 1154158

HAL® VAK Vehicle Access Kit

Description

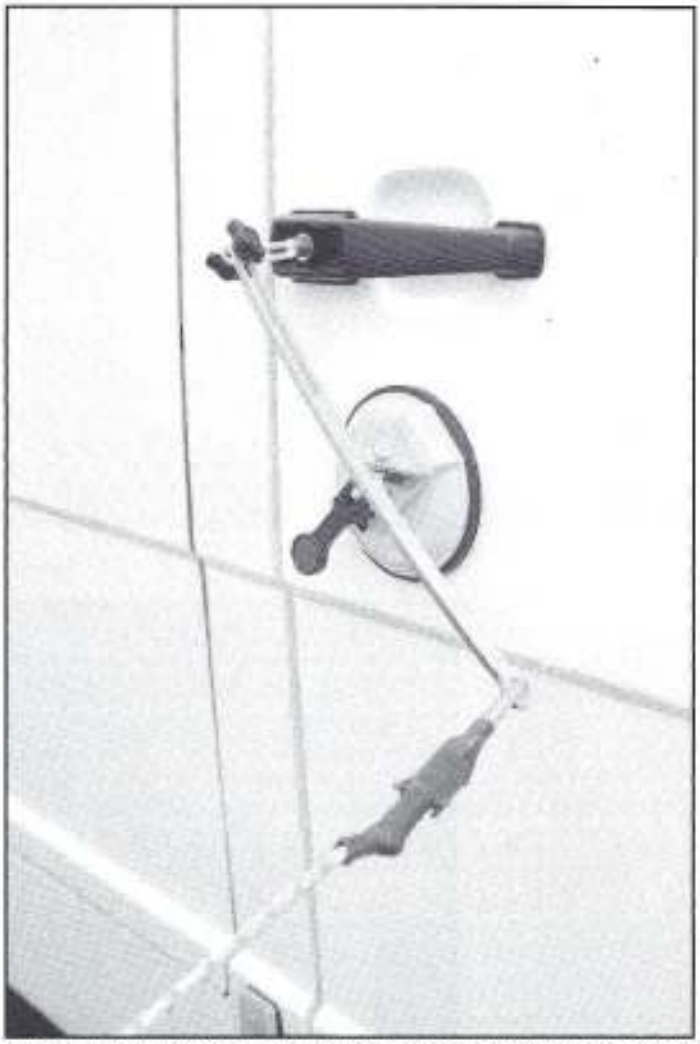
The HAL® VAK kit comprises a range of special access tools for use with HAL® hook and line kits (see separate entries) to assist with remote vehicle entry and clearance tasks. The tools are designed to reduce the time taken for rigging and allow any door to be set up for opening quickly and easily. In addition, the remote operation reduces the risk to the bomb technician.

Each item in the kit is optimised for a specific task. Components are available separately or packaged into a complete kit.

Remote window breaker: this spring-activated tool is designed to smash a vehicle window and allow access to be gained to the interior. The window breaker is pre-armed and then attached using a powerful suction anchor. A line is connected to the trigger arm and, when pulled remotely, the trigger mechanism releases and the window is struck.

Vehicle door handle lifter: this tool deals with lift type handles commonly found on modern vehicles. The telescopic leg sections are first adjusted to the correct height until the 'lifter' is gently braced just under the door handle. When a line is attached to the eye at the opposite end of the lift

The Allen-Vanguard range of car door openers includes a key clamp (Allen-Vanguard) 1154152



The Allen-Vanguard range of car door openers includes a button pusher (Allen-Vanguard) 1154153

The Allen-Vanguard range of car door openers includes a door lifter (Allen-Vanguard) 1154154

lever and pulled remotely, the door catch will release and the door lifter will fall away as the door opens. The lifter easily reaches most car, van and light truck door handles. The tool can be rigged without moving any part of the target vehicle.

Vehicle key/handle clamp: a versatile and robust clamp designed to hold most types of car key securely when attempting to remotely turn the key in a car lock. The turning action is achieved by remotely pulling a line attached to one of the side arms. The clamp can also be attached to lift type handles and other vehicle fittings and used as a lifting device in conjunction with other HAL® equipment and techniques. The clamp can also be used effectively in buildings.

Vehicle door button pusher: this is designed for use with vehicles that have a button push to open the door or other load-carrying spaces. The tool is attached by use of the powerful suction anchor and the lever-action button is aligned with the door button. A line is then attached to the lever and when pulled the button is depressed. The fully adjustable lever-action push arm and single pad suction anchor allow the unit to be fixed to a suitable surface in a variety of single axis orientations.

Window breaker (Allen-Vanguard) 0074835

Status
In production and in service.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

Hands-free head torches

Development
Tiger Tools supply four models of hands-free torches for EOD operators and search teams: the TIGA helmet torch for use on helmets with a pivotable visor, the SL9T flood beam, the TIGA HL-800 for use in potentially explosive atmospheres and the Boxer LED torch.

Description
TIGA This torch was developed for the police and military to use on protective helmets fitted with a pivotable visor. Regardless of the position of the visor, the light can always be focused where needed for total hands-free operation.

SL9T This replaced the TIGA SL8AC. The SL9T is one of the most powerful headlamps on the market, it is intended for conducting detailed searches of buildings, structures or open ground at night or in poor light. Its powerful 20 W flood beam provides the user with excellent peripheral vision as well as offering up to 250 m visibility.

TIGA HL-800 ATEX This model conforms to the latest European safety specification for use in Hazardous Areas Zones I and II and Gas Groups 11A, 11B and 11C. Completely anti-static, it is both robust and waterproof.

Boxer This lightweight torch is designed to meet the demands set by military personnel in the field. Fitted with both white and red LEDs, the torch can be worn on the head or helmet, clipped to a belt or pocket or simply used as a torch. The boxer can swivel vertically through 180°.

Specifications
TIGA
- weight with batteries: 145 g
- range: 100 m
- light: 3 W Luxeon LED; 1/2 and full power settings
- battery: 2–4 x AA
- endurance: 2–4 h
- variable focus beam: spot/wide
- reflector diameter: 56 mm

SL9T
- weight without battery: 250 g
- range: 250 m (approximate)
- battery: 6 V, 8.5 Ah Ni-MH
- endurance: 3–8 h
- operating temperature: –20 to +40°C

TIGA helmet (Tiger Tools) 1368752

The TIGA can be used where explosive gases are present (Tiger Tools) 1368761

TIGA HL-800 ATEX
Ingress protection: IP66/67
operating temperature: –20 to +40°C
beam type: spot
battery: 6 V, 13.5 Ah Ni-MH
endurance: 3 h 10 min (full power), 5 h 15 min (half power)
low-battery warning: light will flash when approximately 15 min of battery left
body and battery parts: anti-static ABS

Boxer
weight with batteries: 90 g
light source: 4 × 5 mm ultra bright LEDs (2 white, 2 red)
batteries: 3 × AAA alkaline
endurance: 150 h
lighting surface area: 40 m²
operating temperature: –25 to +50°C

Status
In production.

Contractor
Tiger Tools Limited.

SL9T in operation (Tiger Tools) 1368750

Handy endoscope search kit

Development
The Handy endoscope search kit was designed for use by law enforcement, customs officers, bomb technicians and technical surveillance countermeasure search teams for searching behind panels, bulkheads, under floors, ventilation ducts, pipes and so on.

Description
The kit comprises of a 122 mm rigid endoscope, coupled to an LED lightsource handle. Viewing inside narrow spaces provides sufficient illumination to see 300 mm away. The endoscope is made from stainless steel and has a 90° lateral direction of view and a 300° field of view. The set is housed in a foam-lined case.

Specifications
Diameter: 12 mm
Length: 300 mm
LED lightsource handle
Weight: 175 g
Dimensions: 140 × 30 × 30 mm
Light output: 1.25 W
Batteries: 3 AAA
Operating time: approx 20 h

Status
In production.

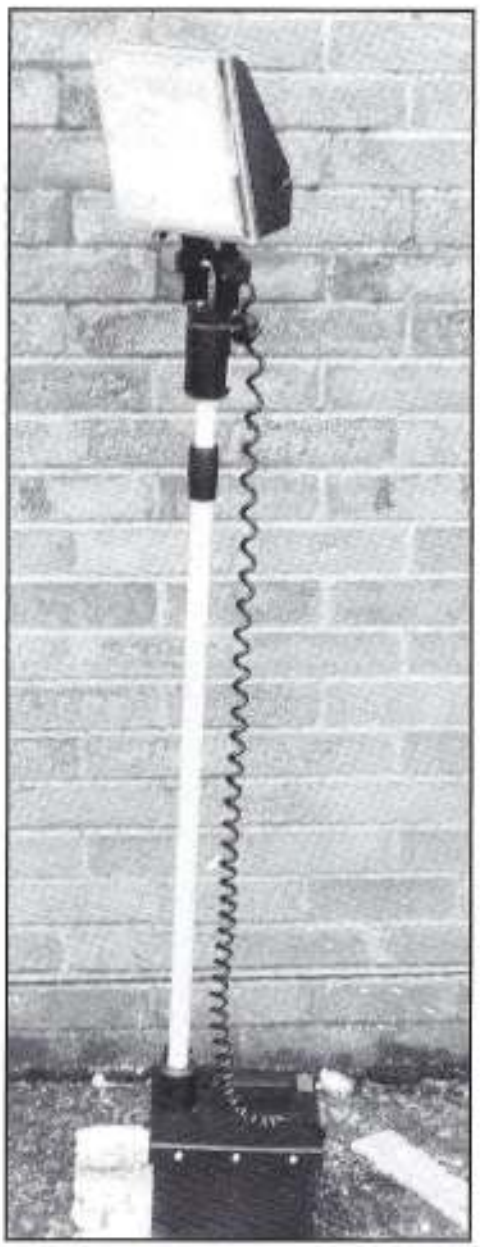
Contractor
Winkelmann (UK) Ltd.

Handy endoscope search kit (Winkelmann (UK) Ltd) 1298765

High-performance search lamps

Description

A range of special, lightweight, high-performance lamps for military and police mobile search operations and scenes of crime investigations are available from SDS.



Maxi 2000 portable rechargeable floodlight (SDS Group Ltd)
0074403

These lamps incorporate the latest generation of rechargeable 'environmentally friendly' batteries which can be safely disposed of or recycled. They do not develop 'battery memory' and can therefore be recharged at any charge state. These batteries can be recharged many times, will retain a full charge for 10 to 12 months and cannot be overcharged. The lamps can also be used directly from a 12 V DC power supply or from a vehicle.

Panther heavy-duty rechargeable searchlight: This 1 million cd searchlight has a borosillicate (Pyrex) lens and can project a beam over 1.5 km. Operated by a single handed rocker switch it can operate for over 1.5 hours on 50 W Xenon light, or for over 4 hours on 20 W Halogen light. The Panther can be recharged in 12 hours. Power is supplied by a 12 V 7A/H lead acid battery.

SDS 800 area-beacon: This is a small portable rechargeable fluorescent area-beacon providing all-round illumination and capable of operating for over 7 hours.

SDS 900 fluorescent floodlight and searchlight: The SDS 900 is a high-performance fluorescent floodlight equivalent to a 150 W lamp. The light can operate for over 7 hours on full charge and can be mounted directly onto the battery pack, extension pole, or used as a hand-held wandering lamp. The searchlight uses a 50 W Xenon bulb to produce a 1 million cd, 1 km beam. It can operate for up to 3 hours of continual use.

Maxi 2000 portable rechargeable floodlighting: The Maxi 2000 is a high-performance fluorescent floodlight equal to a 300 W lamp that can operate for 10 hours per charge. The light has a robust polypropylene case and polycarbonate lens. It can be mounted directly onto the battery pack, extension pole, gripper or magnetic/suction base and can extend to a maximum height of 2.2 m. Power is supplied via a sealed lead acid 12 V 24 A/H battery. The Maxi 2000 weighs approximately 10 kg.

Status

In production and in service.

Contractor

SDS Group Limited.

Panther searchlight (SDS Group Ltd) 0074404

INSYS Lightweight Marking System (LIMAS)

Description

The LIMAS is intended for the delineation of minefields and other hazards, route and lane markings and similar operations. It utilises lightweight picket posts with one end slotted to hold tape, wire or light rope; flanged interface units secured by steel pins (which are club-hammered into the ground or tarmac surface); yellow and red tape on rolls 125 m long and 16 mm wide; and a simple hand-held tape dispenser. Minefield, and other marking triangles or signs, can also be provided. Using this equipment, a two-man team can mark perimeters faster than 1 km/h, making it compatible with mechanical minelaying systems.

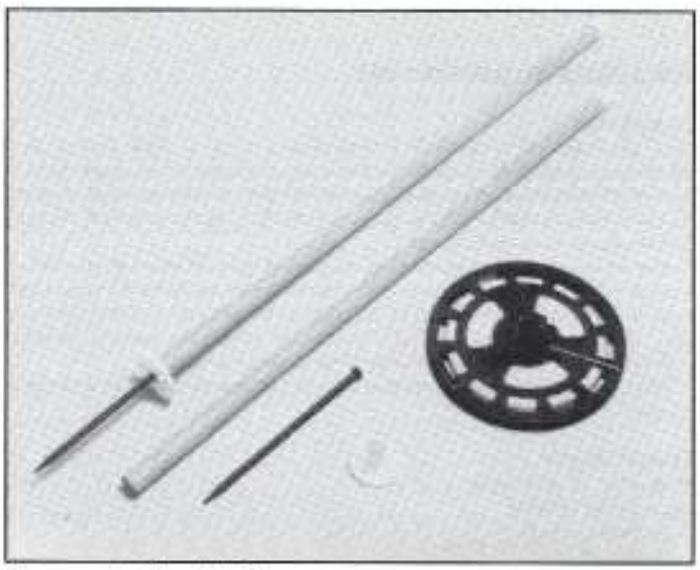
Packaging can be arranged to suit customer requirements. Satchels are available to enable one person to carry a standard LIMAS set sufficient for 250 m of fencing.

Status

No longer in production but can be supplied on request. In service with the British Army.

Contractor

INSYS (a division of Lockheed Martin).



Components of the LIMAS 0511701

Lightweight under vehicle search mirror

Description
This long reach hand-held mirror is designed for searching the underside of vehicles. A tough ABS convex mirror provides a large field of view, which is brightly illuminated by an integral 55 W tungsten halogen lamp. Power is supplied by either a rechargeable batter pack or belt. The mirror is hinged, allowing adjustment to the angle of view.

The mirror is fitted with a handgrip and arm cradle allowing it to be controlled with one hand.

Specifications
Shaft length: 1 m
Mirror: 152 × 213 mm ABS convex
Power supply: 12 V, 8 Ah rechargeable lead/acid batteries
Battery pack weight: 4.8 kg
Battery belt weight: 4.8 kg
Charger: 12 V DC regulated output, 110/120 or 220/240 V AC input

Status
In production and in service.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

Marlin hydro cutting system

Description
The Marlin portable remote hydro cutting system was primarily designed for EOD operations but also has wider application in conventional munitions disposal, demilitarisation operations, improvised explosive device disposal access, counter-terrorist search access, or wherever spark-free and heat-free cutting is required.

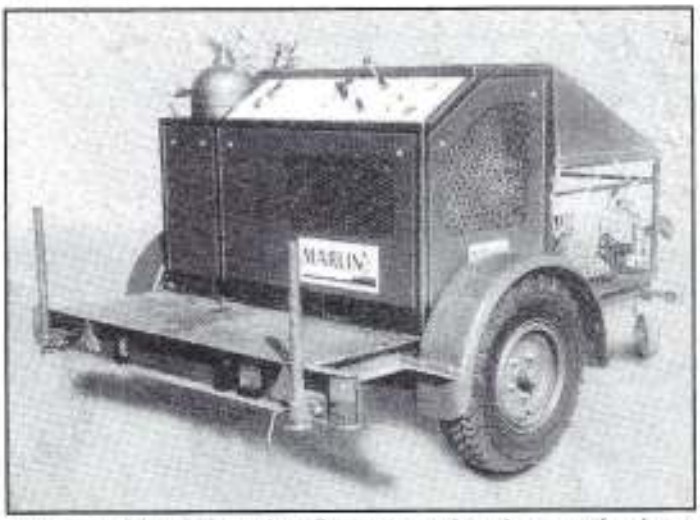
The cutting head can be remotely controlled from safe distances up to 500 m; the operation can then be monitored by closed-circuit television. Marlin's water supply can be drawn from sea water, river or mains, and the equipment will operate in any environment, including subsea surface depths of below 130 m. Garnet, olivine and iron silicate abrasives can be used. Cutting rates depend upon the constituency and thickness of the material; for 10 mm mild steel, the cutting rate is in the region of 180 mm/min.

Marlin is also available with power supplied by a vehicle power take-off. This reduces the size and gross weight of the equipment.

Specifications
Weight: 1,000 kg
Dimensions: 1,000 × 700 × 600 mm
Operating pressure: 3,500 psi (250 bar)
Flow rate: 21 litres/min
Nozzle diameter: 1.6 mm
Power supply: electric, diesel or vehicle power take off

Status
In production and in service.

Contractor
Remotec De-Mil Systems.



Marlin can be quickly and easily transported to the operational area (Remotec De-Mil Systems) 0074331

Live Mk10 1,000 lb general purpose bomb after hydro-abrasive cutting (Remotec De-Mil Systems) 0074332

Miniature inspection set

Description
This set includes a selection of miniature mirrors, light probes and illuminated magnifiers to assist in the internal inspection of suspect cases and containers through small apertures with the minimum of disturbance. It is intended for use by EOD/explosive ordnance reconnaissance, security and scene of crime personnel.

The set includes a battery handle, a range of light probes with diameters from 3 mm and mirror sleeves with diameters as small as 9.5 mm. Light probes can be assembled up to 760 mm in length and include 'flex and stay' models and insulated light guides in acrylic for use in electrical equipment. An illuminated ×8 magnifier is also included.

The kit is supplied in a protective carrying case with batteries and spare lamps.

Specifications
Magnifier: ×8 with lamp
Light probe LP3/50
diameter: 3 mm
length: 50 mm
mirror sleeve diameter: 9.5 mm

Miniature inspection set contents (Allen-Vanguard) 0074270

Light probe LP3/150
diameter: 3 mm
length: 150 mm
mirror sleeve diameter: 9.5 mm
Light probe LP3/200
diameter: 3 mm
length: 200 mm
mirror sleeve diameter: 9.5 mm
Light probes

Diameter	Length	Type
8 mm	75 mm	Right angled, rigid
8 mm	150 mm	Right angled, rigid
8 mm	250 mm	Right angled, rigid
14 mm	380 mm	Flex & stay
14 mm	380 mm	Safety, acrylic
14 mm	380 mm	Fully flexible

8 mm light probe accessories:
19 and 38 mm diameter mirrors, 25 mm elliptical mirror
14 mm light probe accessories
straight extension: 380 mm
adjustable ball and socket joint mirrors: 38 mm and 64 mm diameter
rigid mirror: 38 mm diameter

Status
In production and in service.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

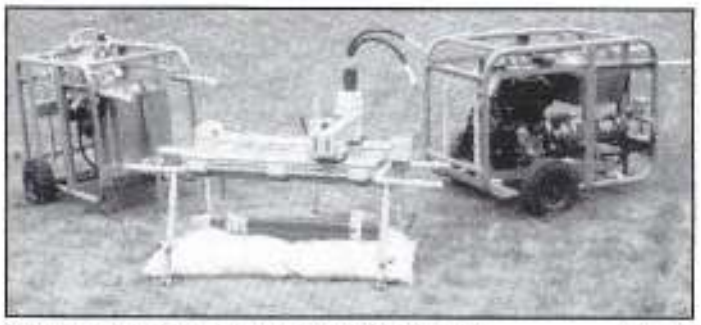
Inspecting electrical appliances (Allen-Vanguard) 0074271

MOS hydro-abrasive cold cutting systems

Description
MOS designs and manufactures five types of hydro-abrasive cutting systems: Viper, Cobra, Mamba, Python and the Anaconda static system. Hydro-abrasive cutting produces virtually no heat and no sparks, grinding or material tension/deformation making it suitable for use in EOD, as well as in other industries such as the petrochemical industry.

Cobra is a medium-sized unit fitted with forklift skids and lifting eyes in a lightweight frame and is designed for EOD use. Cobra is diesel driven with options for trailer mounting. It has a video control unit, built-in electrical generator, water-pump and filtration system. Mamba is the largest unit, similar in design to Cobra but fitted with larger engine and pressure cylinders to provide more cutting power and longer cutting time per cylinder. Viper is the smallest in the range and is a man-portable, lightweight machine. Python sits between Cobra and Viper in the range.

MOS also manufactures a range of dedicated nozzle manipulators. Included in the range are the Manxpro, which makes small circular cuts for precision entries into UXO to allow EOD operators to perform render safe procedures, and the Multipro I, II and III. The Multipro I has two hydraulically driven manipulators, one for circular cuts and one for linear cuts, which work in tandem to produce an 'envelope cut'. The system is rectangular and can be used over a distance of 500 m, using CCTV to view the process. The Multipro II is also hydraulically driven, but uses a lap top computer to produce a pre-set profile cut. The Viper Multipro III is designed to be used without hydraulics and can be used to produce multiple design profile cuts.



Viper with Multipro I astride a 155 mm shell (MOS) 0074420

A range of manipulators is also available with a side-entry cutter to gain side entry into live ordnance for the removal of fuzes and to flush out the explosive contents.

MOS cold cutting sytems are capable of being operated at a distance of over 500 m from the target.

Status
In production and in service.

Contractor
MOS Cold Cutting Systems Limited.

Pocket search mirrors

Description
Pocket search mirrors provide a quick and effective visual search capability for tactical use.

Allen-Vanguard's CMT pocket search mirror is fitted with a convex glass mirror, telescopic arm and a miniature torch. The CMT folds flat for carrying in a jacket/uniform pocket or bag and weighs only 260 g. The mirror can be adjusted for angle and offers a wide field of view. The telescopic handle extends to 460 mm and is rigid to ensure a stable image. The integral torch can be used when the mirror is open or closed.

The TACM2 is a tactical version of the pocket search mirror used when unobtrusive, close-in observation is required. Fitted with an acrylic mirror, it is small, lightweight and robust.

Specifications
CMT specifications
Dimensions: 155 × 90 × 20 mm
Power supply: 2 × AAA batteries
Weight: 260 g

Status
Available.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

The pocket search mirror is ideal for personal security (Allen-Vanguard) 0074272

RE 17 FE 82 Fuze Extractor

Description
This fuze extractor is a device capable of removing certain types of fuze, mechanically and from a safe distance. It comprises a clamping jaw set and cable drum featuring a coil spring and latch set. This enables a sharp torque to be applied when the cable is alternatively pulled and relaxed.

The fuze extractor is normally used in situations where it is inappropriate to use a rocket wrench.

Specifications
Nato stock number: 5120 99 205 7164

Status
In production and in widespread service.

Contractor
Richmond EEI Limited.

Fuze extractor
(Richmond EEI Ltd)
0074841

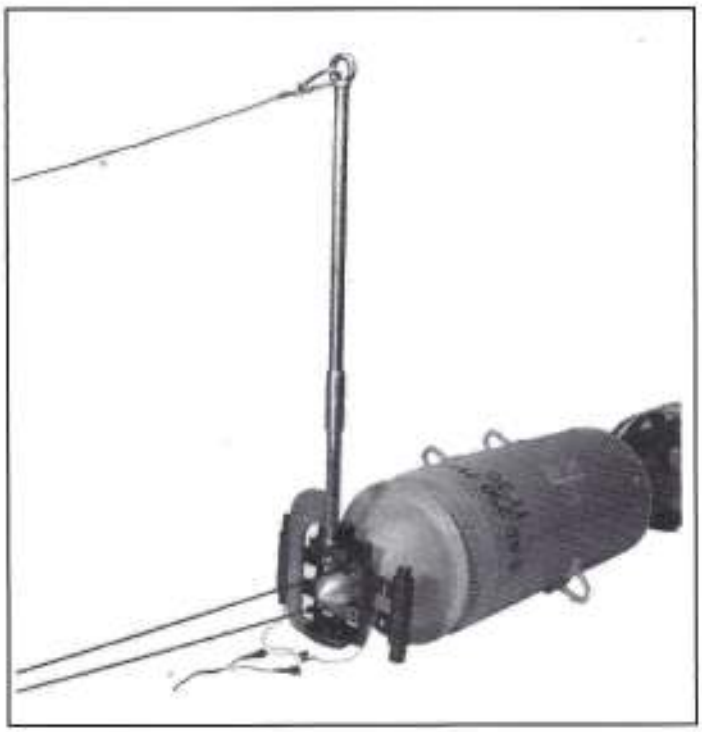
RE 61 HTML High Torque Manual Lever kit

Description
The RE 61 HTML has been designed for use with the RE 61 RW rocket wrench (see separate entry) when dealing with very tight fuses, which may be encountered with certain types of unexploded bombs, or in situations where corrosion around the threads has the effect of locking the fuse.

The rocket wrench is set up in the normal way and the HTML is then positioned. The lever is pulled remotely through 90° at which point the lever falls away from the wrench, which can then be fired in the normal way without re-approaching the target.

Status
In production and in widespread service.

Contractor
Richmond EEI Limited.



RE 61 HTML high torque manual lever
(Richmond EEI Ltd)
0074839

RE 61 RW Rocket Wrench

Description
The RE 61 RW high torque rocket wrench is of modular construction allowing easy maintenance and replacement of parts. It can be deployed in either compact or increased diameter format and can be used either clockwise or anti-clockwise without modification. The wrench has inboard clamping screws that cannot be damaged when it hits hard ground spinning.

The rocket wrench is designed to be fitted quickly and easily. It is powered by two electrically initiated .50-calibre power cartridges.

Specifications
Nato stock number: 1385 99 978 3490

Status
In production and in widespread service.

Contractor
Richmond EEI Limited.

RE 61 RW rocket wrench
(Richmond EEI Ltd)
0074840

RE 88 FNK Freeze Neutralising Kit

Description

The RE 88 FNK Freeze Neutralising Kit is an autonomous cryogenic equipment set. The FNK enables the operator to apply freezing techniques in both EOD and Improvised Explosive Device Disposal (IEDD) applications.

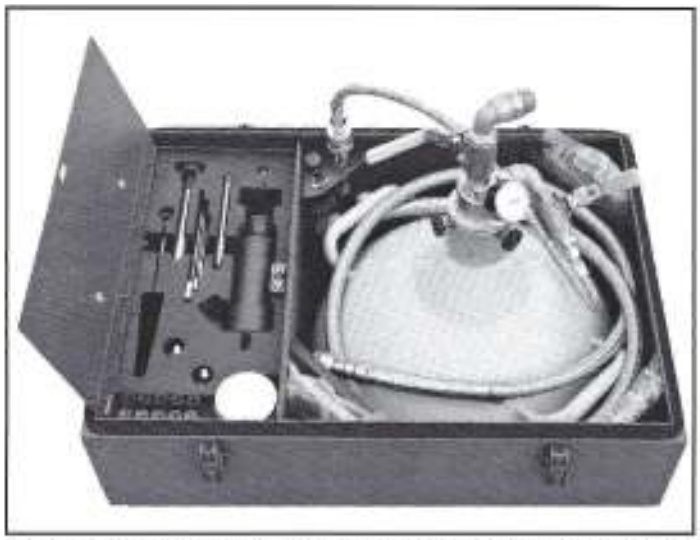
The equipment features adaptors for holding liquid nitrogen around nose and tail and side pocket fuses, and a remotely activated injector kit for penetrating and introducing liquid nitrogen into the target.

Liquid nitrogen can be stored for long periods in the 25-litre insulated Dewar, which is equipped with two pre-set pressure relief valves. The equipment is self-contained and packs into a rugged two-man portable aluminium transit case that can be fitted with an optional mobility pack.

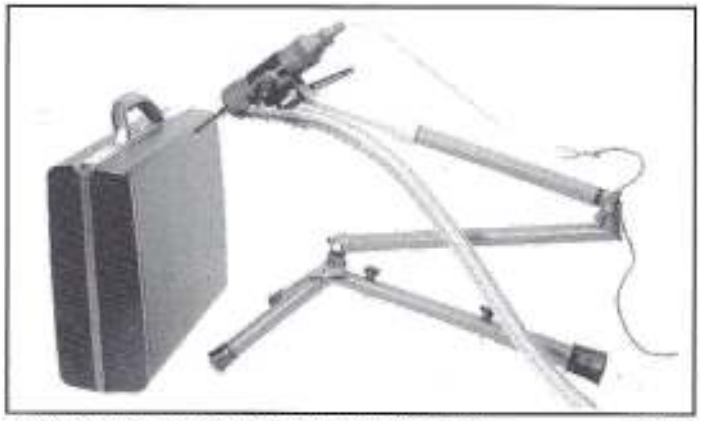
The RE 88 FNK can also be mounted onto a full sized robotic vehicle using the RE 88 FNK Rov system which has been engineered to fit the Remotec Wheelbarrow Mk 8 and the Telerob tEODor.

Specifications

NATO stock number: 1385 99 252 8078



All items of equipment stow within the Transit Case for the RAIK (Richmond EEI Ltd) 1334760



RAIK deployed against soft IED (Richmond EEI Ltd) 1334758

The RE 88 Freeze Neutralising Kit cryogenic equipment set (Richmond EEI Ltd) 0547613

Status

In production and in widespread service.

Contractor

Richmond EEI Limited.

RE 700 Series of Integrated ROV Weapon Carriers

Development

The RE 700 Series of weapon carriers has been designed to carry the Richmond range of recoilless stand off de-armer disrupters, providing a stable and accurate aiming system when it is deployed on a robotic vehicle.

Description

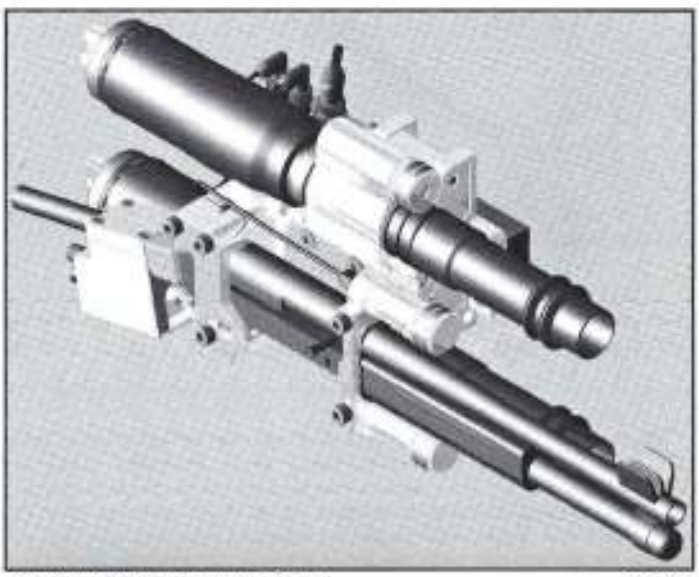
The aiming camera, which is full colour, features auto focus, auto iris, power zoom and three aiming reticles, each of which can be zeroed to a disrupter or shotgun. The aiming camera electronics permit pre-zeroing to four different ranges, which can then be selected on the move via the robotic vehicle's command and control unit.

Specifications

Model RE 700 IRWC-TT: interfaces with Telerob tEODor

Model RE 700 IRWC-Wb Mk 8 & Rev: interfaces with Remotec Wheelbarrow Mk 8 and Revolution

Model RE 700 IRWC-R: interfaces with Remotec Andros, Wolverine and model F6A

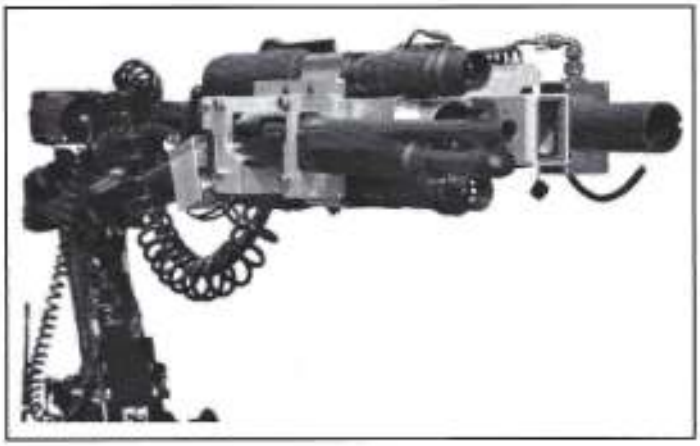


RE 700 IRWC-R (Richmond EEI Ltd) 1334707

The RE 700 IRWC-Tt Series 2 weapon carrier provides a stable and accurate aiming system for the Telerob tEODor (Richmond EEI) 1168190

Status
In production and entered service in 2001.

Contractor
Richmond EEI Limited.



The RE 700 IRWC-Wb Mk8 & Rev carrying two RE 70 M3 Plus 40 mm Disrupters and a semi-automatic, gas operated, 12 g shotgun
1334706

RE 4500 EODM EOD Manipulator

Description
The EOD Manipulator is a remote handling tool designed for use in IEDD operations. It provides the Bomb Technician with a means of reaching forward, to manipulate or pick up an object, at a safety enhancing stand off from the device.

The equipment features a four part box section boom which can be extended to an overall length of 4.5 m. A battery powered Robotic Head and Manipulator enables the Bomb Technician to manipulate or pick up a suspect device or IED with a mass of up to 10 kg.

The rod features an adjustable wheeled Bipod, Control Console, Ballistic Shield to protects hands and console and Variable Counterweight. A high power miniature Tactical Light can be attached to the boom.

Status
In production and in widespread service.

Manufacturer
Richmond EEI Limited.

SDS search/security mirrors

Description
SDS Group manufactures a range of mirrors suitable for general search and inspection.

The range includes a watertight, rubber torch fitted with a circular glass mirror (IM 2100), a watertight torch with telescopic arms (TIM 2300) and telescopic arms without the torch (TM 2350).

A pocket telescopic illuminated mirror (SC 2200) is also available; this consists of a robust handle and stem with a rectangular glass mirror. When closed it will fit neatly into a pocket. The mirror is illuminated and switches on and off automatically when the telescopic arm is extended or closed.

The wheeled trolley illuminated mirror (VM 2500) consists of a convex wide-angle mirror mounted on a mild steel base and illuminated by a fluorescent lamp. The 'T' shaped handle, which assists in tilting the mirror, is telescopic and can be folded for easy carrying.

Specifications
IM 2100
power supply: 2 × 'D' cells
stem length: 500 mm
mirror: 100 mm diameter glass
weight: 810 g

TIM 2300
power supply: 2 × 'D' cells
stem length: 500–1,200 mm
mirror: 140 mm diameter glass
weight: 1 kg

SC 2200
power supply: 2 × AAA cells
telescopic handle length: 210–800 mm
length (closed): 200 mm
weight: 390 g

VM 2500
power supply: integral 110/220 V charging unit
illumination: 12 V 6 W fluorescent tube
mirror: 380 × 340 mm
weight: 9 kg

Status
In production and in service.

Contractor
SDS Group Limited.

Illuminated under vehicle search mirror (SDS Group Limited) 0074323

SDS produces a range of folding, illuminated and telescopic mirrors (SDS Group Limited) 0074322

Search mirrors

Description
These redesigned mirrors are suitable for a wide range of visual search activities by customs officers, border control, police, prison/correctional services, military protection forces, counter-terrorist forces and general security forces.

The mirrors are interchangeable and are set in lightweight black polypropylene frames with screw fixing studs. Protected glass and robust acrylic mirrors are available. The mirrors are used with telescopic arms that are available with or without an LED light pod assembly. The lightweight five-section arm uses an injection-moulded bearing and locking mechanism that holds the arm in the extended position during use. It is manufactured from extruded aluminium with a grey anodised finish

and has an ergonomic profile designed to prevent unwanted arm section rotation and maximise stability in use. The handle is non-slip rubberised for improved grip and comfort. For ease of carrying and storage the arm retracts fully into the handle section. A friction joint at the head allows positive adjustment of the angle of view and allows the head assembly to fold back to lock the unit shut when in the closed position.

The light pod assembly contains 6 ultra-bright LEDs and is deployed on the head adjacent to the mirror to provide maximum illumination.

Specifications

Telescopic arm
- length extended: 1,500 mm
- length closed: 390 mm
- weight without light pod: 543 g
- weight with light pod and batteries: 603 g

Handle diameter: 40 mm
- weight without torch: 450 g
- weight with torch and batteries: 955 g

Short fixed length arm
- length: 470 mm
- weight with torch and batteries: 835 g

Standard mirrors

Size	Type	Weight
38 mm diameter	glass, flat	16 g
64 mm diameter	glass, flat	32 g
64 × 114 mm	glass, flat	68 g
140 mm diameter	glass, convex	127 g
140 mm diameter	acrylic, flat	134 g

Protected mirrors

Size	Type	Weight
64 mm diameter	glass, flat	48 g
140 mm	glass, convex	178 g

Status
In production and in service.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

Special Operations Search Kit

Description
The Special Operations Search Kit from Allen-Vanguard is intended to give 'search' personnel the capability to deploy with a compact, but comprehensive, range of search equipment that will enable them to carry out a wide range of search activities in the most demanding environments and under hostile tactical conditions if required.

The search kit, designed with the help of former British EOD/IEDD personnel, is contained in a backpack that combines comfort and practicality. Internal compartments hold a comprehensive range of equipment including: search mirrors, metal detector, torches, sealing equipment, visual aids, protection equipment, tooling and access equipment. Additional free space allows operators to add their own personal equipment.

An enhance kit is available that includes additional surveillance equipment, including night vision equipment and an infra-red illuminator.

Status
In production and in service.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

The Special Operations Search Kit provides the operator with a compact, but comprehensive, range of equipment (Allen-Vanguard) 1154148

Special Operations Tool Kit

Description
The Special Operations Tool Kit from Allen-Vanguard is intended to give the EOD/IEDD operator the capability to deploy with a compact, but comprehensive, range of tools that will enable him to carry out various tasks in the most demanding environments and under hostile tactical conditions if required.

The tool kit, designed with the help of former British EOD/IEDD personnel, is contained in a backpack that combines comfort and practicality. Internal compartments hold the tools in a range of removable internal pouches and fixed netting compartments. The layout can be changed if required, and free space allows operators to add their own personal equipment.

The tools have been selected for their quality and reliability, with some offering multi-role capability to reduce total weight. The tools offer capabilities for search, access, diagnostics and render safe.

Status
In production and in service.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

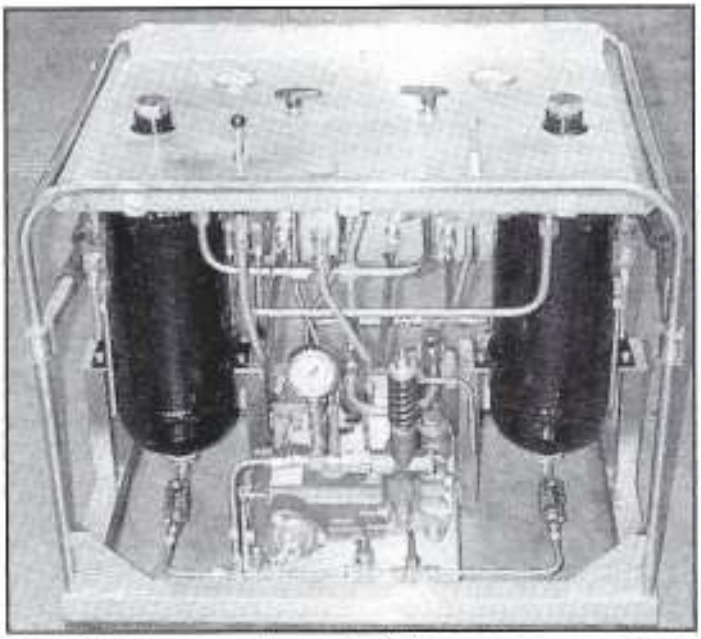
The Special Operations Tool Kit provides the operator with a compact, but comprehensive, range of equipment (Allen-Vanguard) 1154149

Swordfish man-portable cutting system

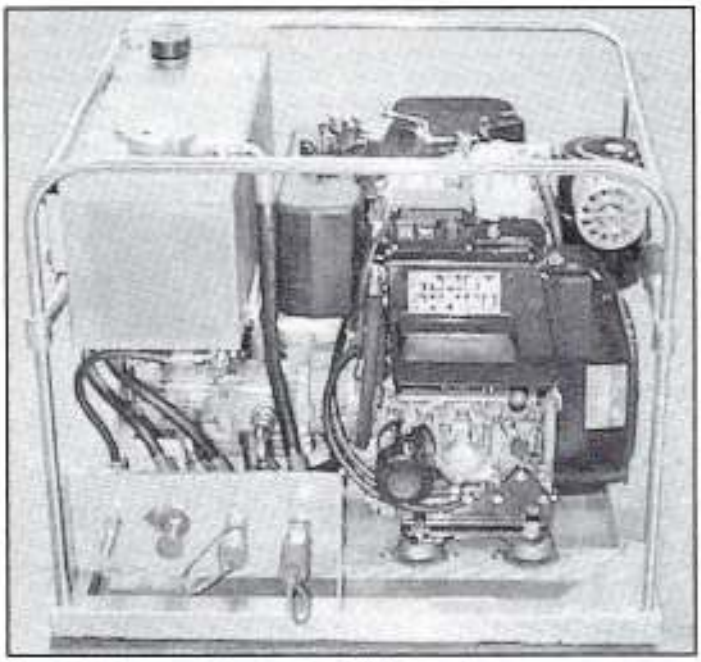
Description
The Swordfish is a man-portable hydro-abrasive cutting system, based upon the Marlin (see separate entry). It consists of two self-contained units, each weighing 118 kg, built into stainless steel frames and fitted with folding handles.

The diesel power pack incorporates a fuel tank, is silenced and has an electric start. The mixing unit has two cylinders, each holding enough abrasive for 10 minutes of continuous use. The triplex pump has a built-in safety valve and operates the system at a maximum pressure of 5,000 psi.

The system allows either linear or circular cuts to be made through casings up to 25 mm thick, for access to explosive fillings. The system can be remotely operated up to a distance of 500 m and will tolerate use with dirty or salt water. The controls for the nozzle manipulator and pump are located on the mixing unit and allow both flow and pressure to be monitored.



Swordfish mixing system (Remotec De-Mil Systems) 0074346



Swordfish Powerpack (Remotec De-Mil Systems) 0074345

Specifications
Mixing unit
Height: 650 mm
Width: 550 mm
Length: 800 mm
Weight: 188 kg
Powerpack
Height: 610 mm
Width: 600 mm
Length: 780 mm
Weight: 188 kg

Rate of work in steel
10 mm thick: 90 mm/min
15 mm thick: 55 mm/min
20 mm thick: 38 mm/min
25 mm thick: 35 mm/min

Status
In production.

Contractor
Remotec De-Mil Systems.

Telescopic Manipulator

Description
The new Telescopic Manipulator, an upgraded version of the original model able to reach further and lift heavier weights, has been developed to enable EOD and Improvised Explosive Device Disposal (IEDD) operators to handle suspect devices and dangerous materials from a relatively safe distance. It can be used with an explosive disruption shield to provide an even higher level of protection for the operator.

This new model is provided with a manipulator 'claw' for grabbing and lifting a suspicious object. The equipment is hand-operated and is supplied with a shoulder strap and an adjustable counterweight. It is designed to help the operator lift an object weighing up to 5 kg.

Specifications
Length:
extended: 5.5 m
folded: 1.5 m
Weight: 17.5 kg
Counterweight: 8 kg
Lifting capacity: 5 kg

Status
In production.

Telescopic Manipulator (SDMS Security Products Ltd) 1334752

Contractor
SDMS Security Products Limited.

Visual search kit

Description
This portable visual search kit is intended for use by explosive ordnance reconnaissance, Revenue and Customs and scene of crime personnel. The kit includes a side-viewing endoscope, a range of search mirrors, fixed length and telescopic mirror arms, fluorescent hand lamp, torches, recovery magnet, miniature mirrors, light probes and illuminated magnifiers.

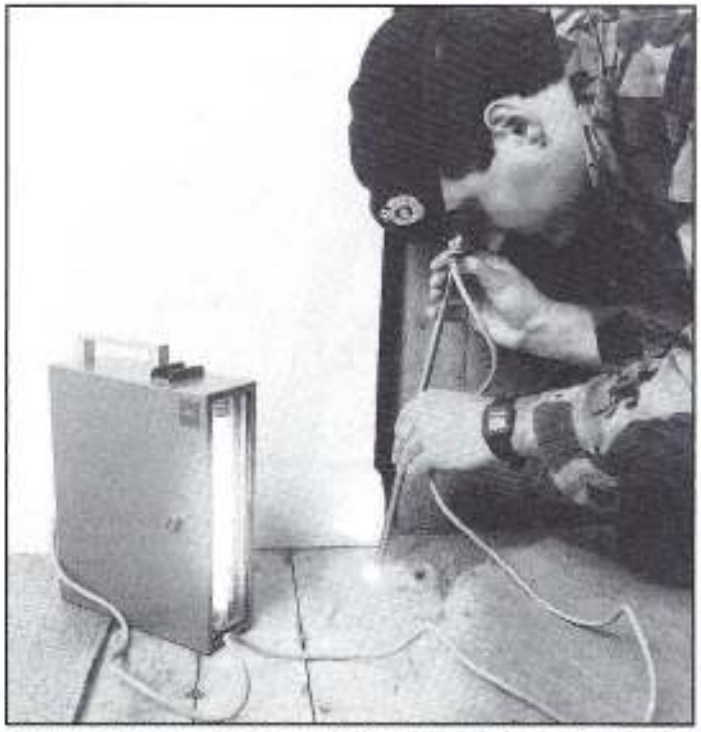
The endoscope is used for searching inaccessible areas through a gap of 10 mm. A 10 W halogen lamp in the tip of the endoscope provides bright illumination and enables inspections to be made over distances of up to 1.5 m. Power for the endoscope is supplied from a secondary power socket in the fluorescent hand lamp.

The range of search mirrors includes a long telescopic model that extends to 1.4 m for inspecting inaccessible areas – in and above containers, for example – and a short fixed length model suitable for room searches. Both can be fitted with interchangeable mirror heads.

A selection of miniature mirrors and light probes and illuminated magnifiers are included to assist in the internal inspection of suspect packages and containers with minimal disturbance. Mirror sizes range from 4.5 mm in diameter.

The kit is supplied in a protective foam lined carrying case complete with batteries and replacement lamps.

Specifications
Hand torch: right angle, 2 C cell (2 per kit)
Hand lamp: fluorescent, 12 W
Endoscope
lamp: 10 W
diameter: 9.65 mm
length: 350 mm



This portable comprehensive search kit allows a wide range of otherwise inaccessible areas to be searched (Allen-Vanguard) 0074282

Mirror arm with torch
length: 500 mm
mirror angle: 45°
power supply: 2 D cell
Telescopic mirror arm
length open: 1,400 mm
length closed: 350 mm
Mirrors

Size	Type	Quantity
140 mm diameter	glass, convex	3
64 mm diameter	glass, flat	2
64 × 114 mm	glass, flat	2

Light probe battery handle: 2 C cell, 2 per kit
Magnifier: ×8 with lamp
Light probe LP2/150
diameter: 2 mm
length: 150 mm
mirror sleeve diameter: 4.5 mm

Endoscopes enable searches of otherwise inaccessible areas to be undertaken (Allen-Vanguard) 1041270

Light probe LP3/50
diameter: 3 mm
length: 50 mm
mirror sleeve diameter: 9.5 mm
Light probe LP3/200
diameter: 3 mm
length: 200 mm
mirror sleeve diameter: 9.5 mm
Light probes

Diameter	Length	Type
8 mm	254 mm	right angled, rigid
14 mm	380 mm	straight, rigid
14 mm	380 mm	flex and stay
14 mm	380 mm	safety, acrylic

14 mm light probe accessories
straight extension: 380 mm
angled extension: 203 mm
adjustable ball and socket joint mirrors: 38 mm and 64 mm diameter

Status
In production and in service.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

VM-X1 under vehicle search mirror

Description
The VM-X1 is an updated version of the trolley-type under vehicle search mirror. The low-profile design includes a shatterproof polycarbonate mirror fitted to a chassis with corner-mounted castors. The large convex mirror, with LED light pod assembly, offers a wide field of view and excellent visual resolution. The composite construction hinged handle can be lowered to ground level for maximum under vehicle penetration, whilst a 3-way locking collar allows the unit to be parked (handle standing up) or collapsed (handle folded down) when not in use.

A single light pod assembly containing 20 LEDs provides illumination. The rechargeable light pod is housed in a robust acrylic housing and has a nominal continuous use life of 7 hours. Fastened to the trolley chassis by two holding clip brackets, the light pod assembly can be used independently as a search lamp. Up to two additional optional light pod assemblies can be fitted to the mirror chassis. The light pod assembly has three modes of operation: On, Off and Movement. In movement-sensitive mode the lamp will switch on automatically when it is moved, and it will remain on for approximately 15 seconds unless moved again.

Specifications
VM-X1
Mirror: 400 × 400 mm
Weight: 2.4 kg
Dimensions
compact: 580 × 540 × 130 mm
deployed: 580 × 540 × 1,020 mm
Ground clearance: 114 mm
Handle length: 930 mm
Light pod assembly
Dimensions: 50 mm diameter × 260 mm long
Weight: 530 g
No of LEDs: 20

The VM-X1 in use (Allen-Vanguard) 1154150

Status
No longer available or in production. Believed that none are in service.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

United States

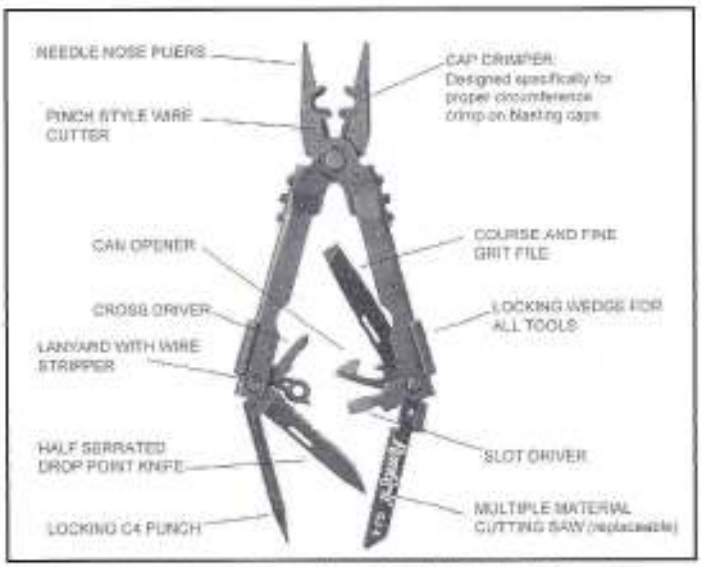
Demolition Explosive Technician (DET) Tool

Development
The Multi-Plier® 600 DET was developed in conjunction with the US military specifically for explosive ordnance.

Description
Manufactured from 410 grade stainless steel with a non-reflective black oxide coating, the tool contains a blasting cap crimper; locking C-4 punch; one handed opening jaw, wire cutter; wire crimper; needle nose pliers; serrated sheepsfoot blade; RemGrit® saw with universal coupler; drop point blade; large, medium and small flat head screwdrivers; cross head screwdriver; bottle opener; lanyard ring; file and standard/metric scale. All components lock into place for safety and convenience and the tool is supplied with a ballistic nylon carrying sheath.

Specifications
Length
overall: 16.79 cm
open: 16.8 cm
closed: 12.8 cm
Weight: 227 g
Handle material: Stainless Steel

Status
In production. In service in Afghanistan and Iraq with the US Military (OEF, OIF) and French forces.


NEEDLE NOSE PLIERS
PINCH STYLE WIRE CUTTER
CAN OPENER
CROSS DRIVER
LANYARD WITH WIRE STRIPPER
HALF SERRATED DROP POINT KNIFE
LOCKING C4 PUNCH
CAP CRIMPER: Designed specifically for proper circumference crimp on blasting caps
COURSE AND FINE GRIT FILE
LOCKING WEDGE FOR ALL TOOLS
SLOT DRIVER
MULTIPLE MATERIAL CUTTING SAW (replaceable)

Demolition Explosive Technician (DET) Multi-Plier® 600 (Gerber) 1299250

Contractor
Gerber Legendary Blades.

Enspecta Jr™ Search Mirror

Description
The Enspecta Jr™ is a lightweight hand-held mirror system for inspecting hard-to-view places such as vehicle wheel wells, under dashboards and seats, engine compartments, the tops of high-profile vehicles, prison bunks and wall lockers.

The device features a convex mirror attached by an adjustable-tilt neck to a retractable pole-style handle. A flashlight with adjustable-angle head is mounted to the handle pole to illuminate the area being viewed.

A deluxe model is available that includes a battery charger with rechargeable flashlight batteries, and a rugged three-castor wheel assembly mounted to the mirror to allow the unit to rest on the ground and roll easily beneath vehicles, furniture and other hard-to-reach spots.

Specifications
Length
retracted: 0.94 m
extended: 1.22 m
Mirror diameter: 21.59 cm

Enspecta Jr™ In use (Criminalistics, Inc) 1041225

Status
In production and in service in the US.

Contractor
Criminalistics, Inc.

Enspecta Jr™ retracted (Criminalistics, Inc) 1041224

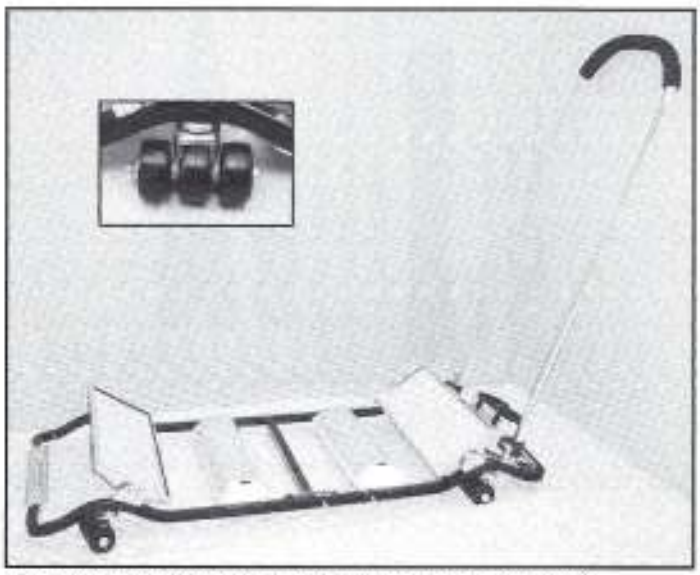
Enspecta™ Vehicle Undercarriage Search System

Description
The Enspecta™ is a horizontal periscope used to conduct a detailed search of the undercarriage of any vehicle. The system comprises dual horizontal periscope mirrors, two powerful fluorescent lights and rugged triple-castor wheels. It is designed to provide distortion-free views of a suspect vehicle at a single glance.

Enspecta™ is lightweight, portable and powered by a 12 V DC gel cell battery and charger. An optional solar panel is available for high traffic areas. The handle folds over the mirror and lights, creating a compact unit which can be quickly stowed for storage or travel.

Also available is the Enspecta Jr™, a hand-held illuminated search mirror for checking otherwise difficult to access areas such as wheel wells, engine compartments and the tops of high-sided vehicles (see separate entry).

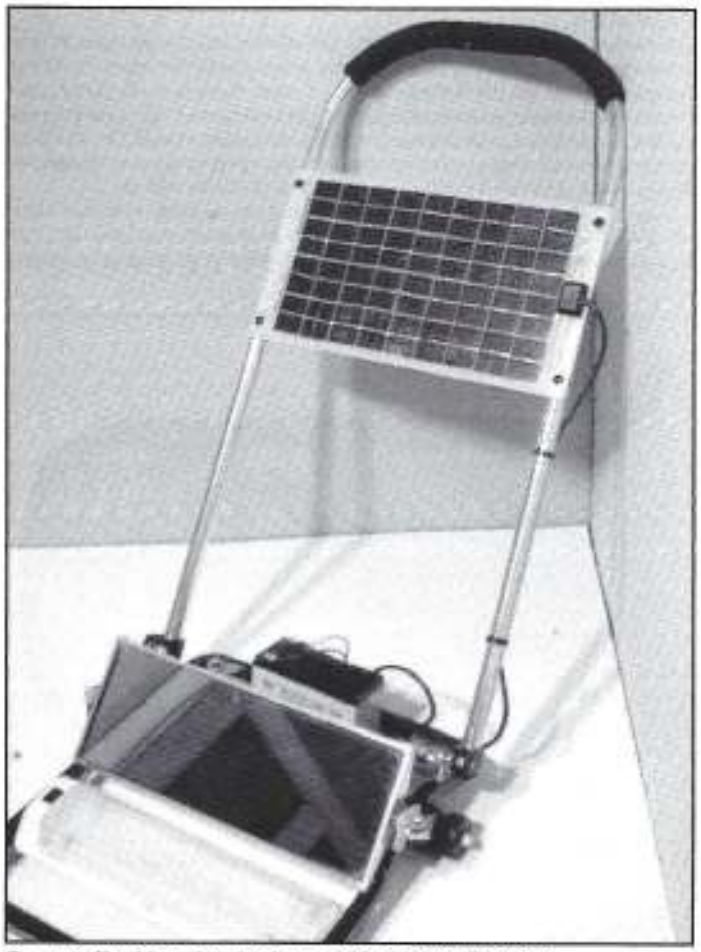
Specifications
Height: 148 mm
Weight: 13.5 kg



The Enspecta™ with close-up detail of the triple-caster wheels
(Criminalistics, Inc) 1041229

Status
In production and in service in the US.

Contractor
Criminalistics, Inc.



Enspecta™ with optional solar panel for high traffic areas
(Criminalistics, Inc) 0546831

Hooks and lines

Description
SAS R&D Services manufactures a number of product series containing various hooks and lines, together with useful associated equipment. The First Generation hooks and lines kit, superseded by other product lines but still widely used, comes complete with a metal case and 100 m reel fixed to the lid. The Second Generation kit includes a range of self-gripping tools and extra ropes for more complicated applications. The range of suction pads makes this kit especially useful for working on vehicles, as these will attach securely to bodywork or glass. The kit comes complete with a metal case and two separate colour-coded reels. The Third Generation is a heavy-duty set for moving vehicles or other heavy suspect devices, containing a range of rated slings and heavy duty snatch blocks. It comes with a 150 m line and canvas carrying case. The Fourth Generation is an extended range designed for use in buildings. Snatch blocks designed to open automatically allow suspect devices to be taken along more complex routes and doorway anchors allow equipment to be supported across doorways. A single reel is included and the kit comes complete with a canvas carrying case and a 3 m telescopic pole.

SAS R&D also manufacture a backpack hook and line kit and a Gamma Bergen hooks and lines kit. The latter allows instruments to be stored on the bergen in clear and netting pouches which can be easily detached and exchanged using Velcro fasteners. There is space available for additional items selected by the technician. The bergen is provided with a detachable, smaller bergen which can be used to go further forward for specific tasks. The kit includes 100 m of Kevlar rope, a selection of search mirrors and telescopic arms, a range of hooks, anchoring devices and attachment tools, plus an automatic pulley opening system.

Status
Available.

Contractor
SAS R&D Services.

Mini-Mirror search series

Description
The mini-mirror search series is designed to offer innovative small tools to suit a variety of problems requiring reflection, magnification or retrieval. Each of the items in the range feature different length non-flexible or telescoping pole lengths, ranging from about 15 to about 83 cm long, together with various size mirrors, magnets, pilot lighter or magnifying glass. Each item can be used individually or combined within technicians' kits, thus increasing user flexibility.

Status
Available.

Contractor
SAS R&D Services.

For details of the latest updates to *Jane's Explosive Ordnance Disposal* online and to discover the additional information available exclusively to online subscribers please visit
jeod.janes.com

Titanium mine probe kits

Development
The DET Delux Mine Probe Kit was developed for Explosive Ordnance Specialists for mine detection and disposal.

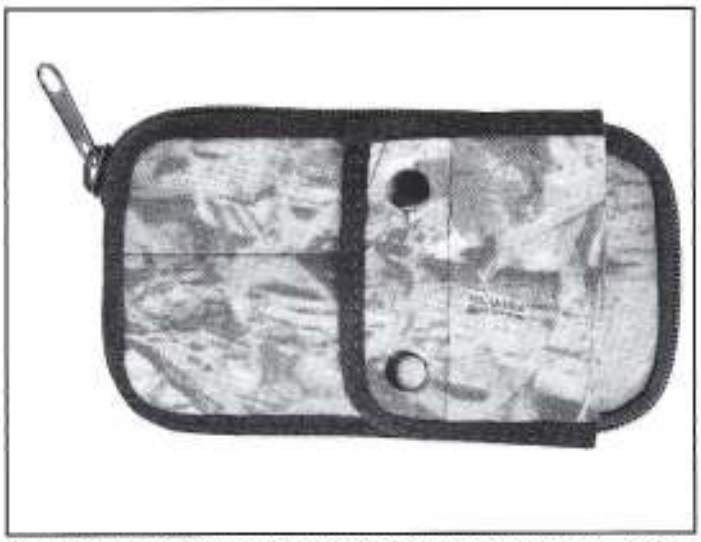
Description
The Gerber titanium mine probe kits contain six tips; three titanium and three Delrin® plastic. The titanium tips are suitable for most demining situations while the Delrin® tips are used when there is a danger of static electricity. During operations the tips do not need to be filed: a new tip can quickly be screwed onto the handle and probing continued. The titanium rods can be used singly or in combination, according to the circumstances. The probe length can be extended from 6 to 18 inches in total.

The DET Delux Mine Probe Kit contains three-piece titanium rods, one Delrin® handle, three titanium tips, three Delrin® tips, one DET tool (see separate entry) and a Streamlight Stylus torch all housed in a black ballistic nylon sheath that attaches to an H-harness, web belt or Molle vest. The basic DET Mine Probe Kit is similar to the Delux kit, but does not contain the DET tool or torch.

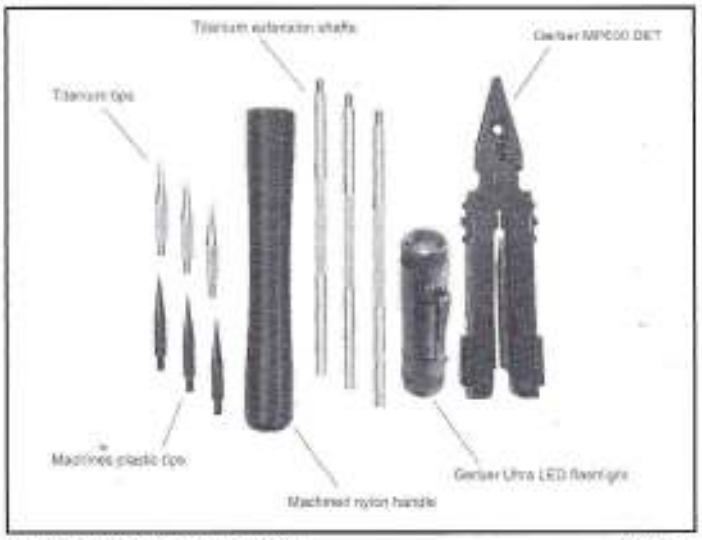
Specifications
Dimensions (kit): 22.5 x 2 cm
Length of shaft: overall 25 in
Case material: ballistic nylon
Battery: 1 AA
Operating time: 40 hours
NATO stock number: 5180-01-516-3229

Status
In production. In service around the world.

Contractor
Gerber Legendary Blades.



The mine probe kit comes in a compact storage pouch (Gerber) 0529595



Mine Probe Kit Deluxe (Gerber) 1289251

Gerber's Delux Mine Probe Kit has changeable titanium and Delrin® tips (Gerber) 0529596

EOD WEAPONS
Canada

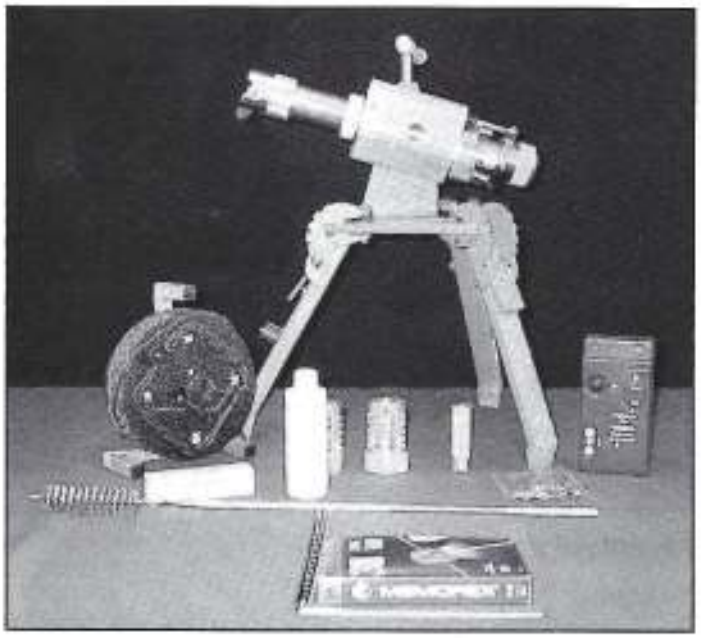
Neutrex 29 mm water-jet disruptor

Description
Following an extensive research and development programme conducted in association with the Royal Canadian Mounted Police and EOD technicians of the Sûreté du Québec, Proparms developed a 29 mm version of the Neutrex disruptor.

Capable of rendering safe improvised explosive devices larger than 9 kg, with shock-absorbing and recoil reduction capabilities, it is now felt by the manufacturer that the 29 mm calibre Neutrex is at the limit of recoil force and weight that can be robot-mounted.

Status
In production. In service in North America and over 60 other countries worldwide.

Contractor
Proparms Limited.



Neutrex 29 mm water-jet disruptor
(Proparms Ltd)
0529582

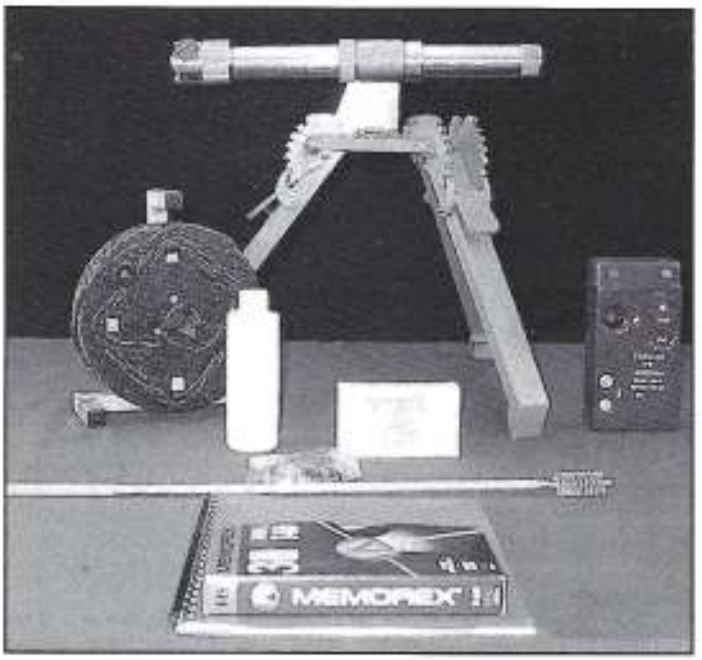
Neutrex 20 mm water-jet disruptor

Description
The 20 mm Neutrex disruptor, a stainless steel barrel mounted on an adjustable steel stand, fires a 100 ml slug of water to disrupt EOD and improvised explosive device threats. The ammunition is self-contained, requires no hook-up wires and is available in varying strengths. Ignition voltage is relatively high, 24 V+, in order to eliminate the risk of premature functioning. The disruptor can be fired at a distance of 3 m or more from the target with the aid of a laser aiming system and a removable breech safety pin has been added to reduce the risk of premature firing. The barrel is cylindrically bored to permit the firing of solid steel slugs. The Neutrex weighs approximately 11 kg and can be set up in less than three minutes.

Also available for the 20 mm are Avon-type frangible rounds for pipe bomb disarming and a non-electric adaptor.

Status
In production. In service in North America and in more than 60 countries worldwide.

Contractor
Proparms Limited.



Neutrex 20 mm water-jet disruptor with laser aiming system
0529683

Recoil Absorbing Mechanism (RAM)

Development
The Recoil Absorbing Mechanism (RAM) was designed to accommodate the 20 mm Neutrex Waterjet Disrupter when firing from small- and medium-sized robotic platforms.

Description
The RAM may also be mounted on a disrupter stand. Based on the design of the 29 mm Assembly, the RAM reduces the suddenness of the recoil impact by 40 per cent when robot mounted and approximately 30 per cent when mounted on a stand. The RAM can be fired using the Neutrex ammunition (70-85 grain). The RAM can be operated in all weather conditions.

Specifications
Length: 26 cm
Width:
(ram body) 14 cm
Weight:
(unit only) 2.2 kg
(with disruptor) 5 kg

Recoil Absorbing Mechanism (RAM) (Proparms Ltd) 1299255

Composition: stainless steel and aluminium, 304, 6065-T350
Recoil system: combination spring activated; reduction:
40% robot mounted
30% on stand

Status
In production.

Contractor
Proparms Ltd.

Recoilless 12.5 mm disruptor

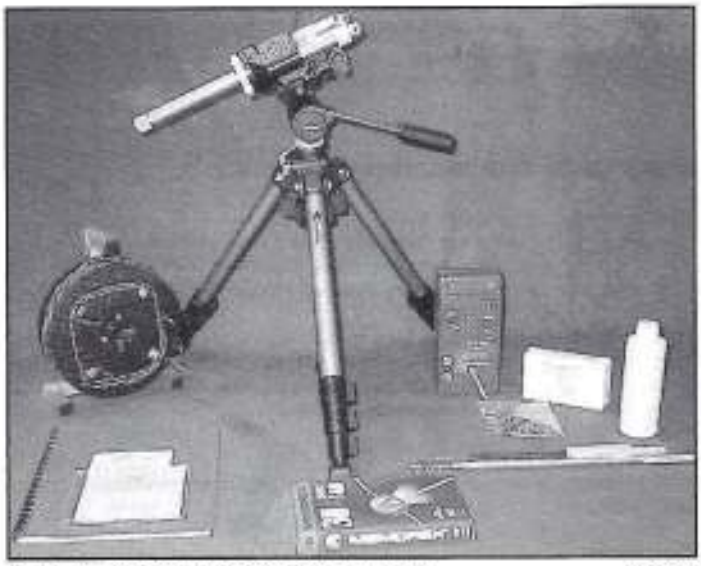
Description
Proparms' recoilless 12.5 mm disruptor is a compact, lightweight disruptor, the weight of the disruptor alone being approximately 1.5 kg. It is designed for small, remotely operated vehicle deployment and its ammunition and projectiles (solid, frangible or liquid) permit precise disruption of the threat. The power cartridge can be electrically or non-electrically activated. The calibre is based on the .45 Long Colt. Its design also permits the use of 410 shot shells for special applications.

Small packages up to 100 × 150 × 240 mm and steel pipes up to 25 mm may be successfully disarmed and the simplicity of construction and ease of maintenance gives long and reliable service. The set-up time (pre-loaded with water) is approximately 1 minute.

The disruptor can be carried in a rucksack, along with its camera tripod stand, wire wheel and accessories. It is also available in a travelling container with a scaled-down version of the original stand.

Status
In production. In service in North America and in more than 60 countries worldwide.

Contractor
Proparms Limited.



Proparms 12.5 mm disruptor (Proparms Ltd) 0529584

Recoilless 20 mm disrupter

Description
The 20 mm recoilless disrupter is designed to meet the requirement for a medium-powered and accurate recoilless water-jet disrupter with the capability of employing Avon-type, frangible rounds as well as solid steel slugs.

The disrupter can be positioned in very confined spaces and employed with a variety of support arrangements. A collapsible stand can be provided, or the disrupter can be mounted on a photographer's tripod. Proparms recoilless technology allows for the disrupter to be used on robotic platforms without causing damage to sensitive robotic parts.

As of June 2008, Proparms Limited have designed a new lightweight version of the 20 mm recoilless disrupter. At less than 5 kg when fully loaded with water and ammunition, it is ideally suited for robotic applications. The recoiless 20 mm disrupter has a disrupting capability effective range up to 1 m (3 ft).

Status
In production and in service.

Contractor
Proparms Limited.

Recoilless 20 mm disrupter (Proparms Ltd) 0529586

Czech Republic

Tarantula disruptor

Description
This is an 18 mm calibre weapon distributed under the trade name of the Tarantula. It is a single-shot weapon, specifically designed for disrupting and destroying explosive charges and suspicious objects without causing detonation, using a high-pressure water jet. When utilising alternative loads (slugs and so on), it can be used to shoot through a variety of barriers. The water jet propulsive impulse ranges from 350 to 3,000 m/s.

Tarantula consists of a monobloc barrel into which the breech, with integrated electrically discharged firing mechanism, is threaded. The assembly is then seated onto a locking cradle equipped with a spring-loaded recoil braking mechanism. The cradle is mounted onto an adjustable tripod carriage supported by a ball joint pivot; height, traverse and elevation angle may be set within listed technical specifications.

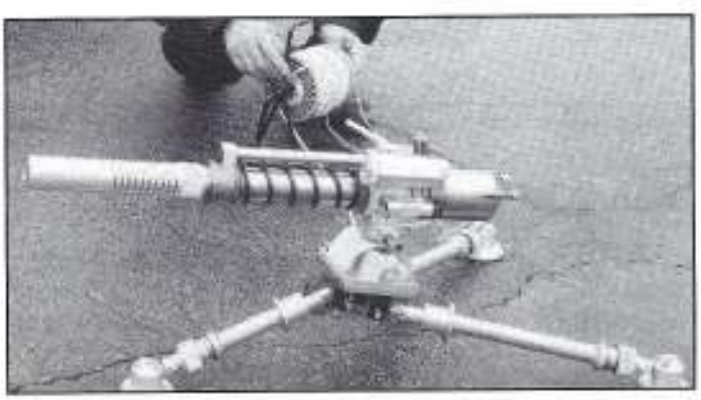
Aiming is conducted through the use of a laser sighting device which can also be used as a range-finder. The weapon is adapted for optical sighting device mounting.

The disruptor is fired by a remote-control box. The tripod legs are fitted with anti-skid discs to ensure stable positioning of the whole assembly during discharge.

Specifications
Calibre: 18 mm
Barrel length with attachment: 580 mm
Max working pressure: 400 MPa
Discharge height: min 220 mm/max 540 mm
Elevation range: –30 to +30°
Traverse range: –45°
Min/Max leg spacing: 250 mm/700 mm
Total weight when ready: max 20 kg

Status
No longer in production.

Contractor
Ceská Zbrojovka.



Tarantula being positioned for use
0023350

Germany

AQUASET single use disruptor

Description
AQUASET is a simple and easy to use disrupting tool that can be deployed against small targets.

Specifications
Propellant weight: 20 g
Charge: water
Ignition: electrical
Length: 170 mm
Diameter: 28 mm
Weight: 155 g
Weight, 100 rounds, packed: 16 kg

Status
Available and in service with several military and police EOD/IEDD teams worldwide.

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.

AQUASET disruptor components (telerob)
0120996

Disruptor EG-2

Development
The EG-2 is designed to disrupt fuze mechanisms either using water or steel bolts.

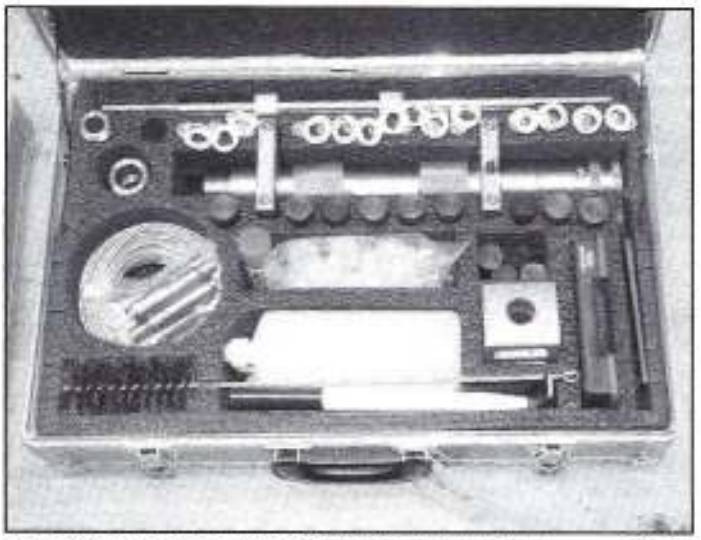
Description
It can also be used to open door locks and to destroy suspect objects in confined spaces such as vehicle boots. It can be hung from a tripod and used over a cavity in the ground.

The disruptor consists of: a barrel with a muzzle cap (for water) or muzzle break (for steel bolts) in the front and a mechanical cover at the rear, various screw on barrels for different propulsive charges, ignition device with integrated ignition circuit tester, tools and transport case.

Various cartridges, a range of ignition systems and accessories such as a laser pointer, tripod stand and an adjustable stand are available.

Specifications
Penetrating power
water load: 15,000 kg/cm²
steel bolt (320 g hardened steel): 10 m steel plate
Dimensions: 630 × 440 × 170 mm
Weight: 23.5 kg

Status
In production.



EG-2 disruptor components in carrying case (Force Ware) 1041277

Contractor
Force Ware GmbH.

DYNERGIT disruptor

Description
DYNERGIT is a universal, high performance disruptor for disabling explosive and incendiary devices at a safe distance. The transfer of energy can be executed using steel, light metal, wooden, plastic or water-filled projectiles. The simple design of the system means it can be deployed virtually anywhere, indoors or out. It is available as a standard 1-barrel set or in an expanded 2-barrel version.

Specifications
Dimensions, deployed
length: 45 cm
height: 12 cm
width: 12 cm
Dimensions, packed
length: 62 cm
height: 22 cm
width: 50 cm
Weight, deployed: 8.3 kg
Weight, packed: 22 kg
Cartridge: DYNERGIT 20 × 67 mm

Status
Available.

The DYNERGIT disruptor (telerob) 0077654

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.

PORTAS door opening system

Description
PORTAS is a low recoil, ballistic door opening system designed to facilitate access to buildings or locked rooms. A powerful water jet with a speed of 300 m/s is claimed to break most locks and open doors quickly and reliably. The device is designed to reduce recoil and can be fired hand-held. The hand-unit can be used on both left- and right-hinged doors without danger to the operator.

The water charge is accelerated by an electrically initiated 20 x 67E mm DYNERGIT cartridge, which can be fired either by the hand-unit provided, or by any other ignition device.

Specifications
Dimensions, deployed
length: 70 cm
height: 35 cm
width: 15 cm
Weight, deployed: 15 kg
Cartridge: DYNERGIT 20 x 67E mm

Status
Available and in service.

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.

TEL220 disruptor for 12.7 mm cartridges

Description
The TEL220 is a robust disruptor for 12.7 mm cartridges used for disabling explosive and incendiary devices. The device is employed by bomb disposal engineers from the military, the police and by specialists engaged in unexploded ordnance (UXO) disposal and explosive remnants of war (ERW).

Specifications
Dimensions, deployed
length: 25 cm
height: 10 cm
width: 10 cm
Dimensions, packed
length: 46 cm
height: 19 cm
width: 32 cm
Weight, deployed: 5 kg
Weight, packed: 12 kg
Cartridge: 12.7 mm

Status
Available and in service.

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.

TEL220 disruptor components
(telerob)
0120897

TEL 221 de-armer/disruptor for 20 mm cartridges

Description
This is a more powerful version of the 220 de-armer/disruptor (see separate entry), achieving higher penetration. Using an electrically initiated 20 x 102 mm cartridge to accelerate the charge the device can be used to disrupt or dearm a wide range of hazardous objects.

The TEL 221 is supplied complete with a rigid transport case, cleaning tools, a range of steel, plastic and wooden slugs and small containers suitable for storing other charges such as sand or water.

Specifications
Length: 0.47 m
Width: 0.31 m
Height: 0.19 m
Function: single-loaded, screw-type breech
Cartridge: IMPULSE 20

Status
In production. In service with several military and police EOD/IEDD teams worldwide.

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.

TELEMACH disruptor

Description
The TELEMACH disruptor is a stand-off ballistic device for disarming explosive and incendiary devices at ranges of up to 10 m. It can be used with the TELEMACH quadpod, which comes with an integrated transport roller and ignition cable drum, or with the tEODor robot (see separate entry). It employs the electrically ignited 20 mm DYNERGIT cartridge (see separate entry) and an integrated laser pointer helps with aiming.

Specifications
Dimensions, deployed
length: 86 cm
height: 12 cm
width: 22 cm
Dimensions, packed
length: 97 cm
height: 16 cm
width: 46 cm
Weight, deployed: 12 kg
Weight, packed: 20 kg
Cartridge: 20 mm

Status
In service.

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.

South Africa

NTW 20/14.5 anti-matériel rifle

Description

The 20 mm NTW 20/14.5 anti-matériel rifle has a number of applications, including Explosive Ordnance Disposal (EOD).

The barrel, bolt, magazine and sighting equipment can be interchanged between 20 mm and 14.5 mm calibre as required; changing from one calibre to another takes less than 30 seconds. Rounds are fed into the rifle from a three-round box magazine protruding from the left-hand side of the receiver and providing fuse protection. Spent cases eject to the right as the bolt is withdrawn.

The NTW 20/14.5 is a manual bolt-action rifle with the bolt face employing six locking lugs. A large double baffle muzzle brake and a combined hydraulic/pneumatic damping and buffer system limit recoil. Two hydraulic dampers are available for use in either warm (+10 to +60°C) or cold (–25 to +35°C) climates.

Recoiling parts slide within a chassis frame which includes the butt assembly, so the firer can assume a conventional firing position with the butt held into the shoulder by a grip under the frame and a pistol grip for the adjustable pull and detachable trigger assembly. Right- and left-handed firing positions are possible. The recoiling parts and the barrel can be removed from the chassis frame for maintenance and also for carrying.

The bipod provides 15° of traverse each side. In addition, the handgrip under the butt can be lowered to act as a monopod.

The optical sight used is a long eye relief (250 mm) 8 × 42 scope with parallax adjustment and a rapid detachable mount. The scope mount is fitted with the Strydom Elevation Drum which enables the firer to go through the full range without readjusting the scope once it has been zeroed at short range.

The rifle may be carried on two special backpack harnesses, one load weighing 12 kg and the other 15 kg. One pack carries the frame, stock, butt and bipod while the other carries the barrel, sighting equipment and magazines.

A further modification of the NTW rifle involves the provision of suitable barrels and other components to allow the rifle to fire either 12.7 × 99 mm (.50 in Browning) or 12.7 × 107 mm ammunition.

NTW anti-matériel rifle in 20 mm form 0037087

NTW 20 × 110 mm anti-matérial rifle (Denel Land Systems) 1132766

Specifications

20 mm version

Cartridge: 20 × 83.5 mm MG151
Operation: manual bolt action
Locking: 6 lugs
Feed: 3-round box magazine
Weight: 26 kg
Length: 1.795 m
Barrel: 1 m
Rifling: 1 turn in 560 mm
Sights: telescopic, long eye relief (250 mm), 8 × 42
Muzzle velocity: 720 m/s
Muzzle energy: 28,500 J
Max effective range: >1,300 m

14.5 mm version

Cartridge: 14.5 × 114 mm
Operation: manual bolt action
Locking: 6 lugs
Feed: 3-round box magazine
Weight: 29 kg
Length: 2.015 m
Barrel: 1.22 m
Rifling: 1 turn in 406 mm
Sights: telescopic, long eye relief (250 mm), 8 × 42
Muzzle velocity: 1,080 m/s
Muzzle energy: 30,675 J
Operational range: >1,800 m

Contractor

PMP, a division of Denel (Pty) Limited.

Status

In production. In service with the South African National Defence Force and with an unspecified South Asian nation.

United Kingdom

ABL900 Dragon de-armer

Development

AB Precision's Dragon de-armer (ABL900) has been designed to minimise recoil down to approximately 5 m with no loss of performance.

Description

The de-armer projects a variety of steel slugs at high velocity into the fuzes of air dropped bombs and of some items of land service ammunition. In use the de-armer is placed close to the target, aimed at the fuze and fired remotely or electrically causing the steel slug to either shear the exposed fuze parts or severely damage the fuze to prevent it from functioning.

A standard .50 calibre electric propelling cartridge is used. Recoil is reduced by tapping off excess gas from the bore and using this to counteract the recoil forces generated. There is no requirement to use another cartridge in opposition and operation is not slowed by the need to fit add-on recoil reducing devices.

The equipment comprises a recoil reducing barrel with cartridge chamber and breech plug. An optional anti-roll/tether device can be fitted, especially for situations where there is a danger of losing the de-armer upon firing, such as on a river bank or adjacent to a ship's side.

The Dragon is manufactured from corrosion-resistant materials.

Dragon de-armer (AB Precision (Poole) Ltd) 0074235

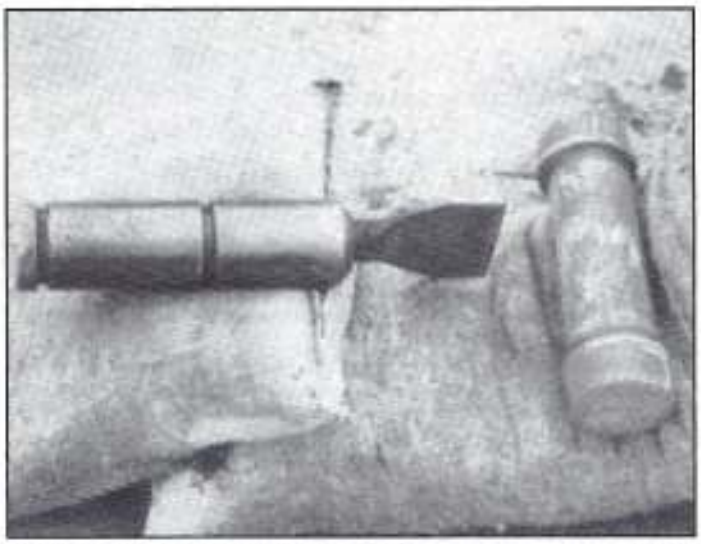
Specifications

Standard
Length: 205 mm
Diameter: 60 mm
Weight: 3.5 kg

Recoiless
Length: 385 mm
Diameter: 60 mm
Weight: 6.5 kg

ABL 900 complete kit (AB Precision) 1299220

Container
Size: 490 × 295 × 160 mm
Weight: 20 kg
NATO stock no: 1385-99-004-0261



ABL 900 against pipe bomb (AB Precision) 1299221

Status
In service with the UK MoD and worldwide.

Contractor
AB Precision (Poole) Limited.

ABL1000 recoilless de-armer and disruptor

Description
Developed as a dual-role piece of equipment to defeat the threat posed by more complex, better protected improvised explosive devices (IEDs) and also to deal with unexploded ordnance (UXO), the ABL 1000 de-armer disruptor is recoilless during operation.

When used as a disruptor the ABL 1000 will be set up close to the suspect device and aimed at the firing circuit. On firing it projects a slug of water into the device, disrupting the firing circuit without causing detonation of the device's explosive contents.

As a de-armer, the ABL 1000 will project a variety of steel slugs into the fuzes of air dropped bombs and some land service ammunition. A bolster slug enables it to be used against other UXO as well as being effective against metal-cased IEDs.

The ABL 1000 is a multishot device, capable of many firings without distortion. It requires minimal maintenance and can be used for EOD/IEDD training without affecting its operational performance. The device can be accurately positioned with or without the robust, lightweight stand. Its recoilless design also allows it to be fitted to a remotely operated vehicle (ROV) with no damage to the vehicle.

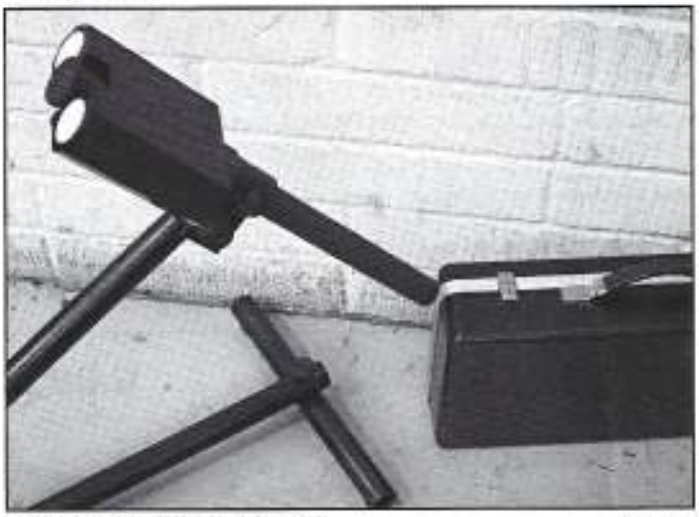
The system is constructed from anti-corrosion precision-machined parts, which are subject to the most demanding quality control during manufacture. Flow detection tests as detailed in MFD601, then crack detection and over proof firings are carried out before the ABL 1000 is accepted into service.

Training and maintenance is simple and all tools and equipment are supplied. Spare parts and consumables are contained in the kit. With correct maintenance, AB Precision claims that the barrel life is virtually unlimited.

Standard electrically fired .50-calibre cartridges are used and these are supplied in units of 77, packed in H83 ammunition containers.

The ABL 1000 is supplied as a complete kit in a robust shock-tested metal container.

Specifications
Disruptor
overall length: 515 mm
weight: 4.5 kg
De-armer
overall length: 294 mm
weight: 3.5 kg



ABL 1000 disrupter (AB Precision) 1299211

ABL 1000 in use and fitted to cyclops (AB Precision) 1374874

ABL 1000 cased (AB Precision) 1299210

Container
dimensions: 873 x 428 x 187 mm
material: aluminium
colour: NATO green
Weight of kit: 25 kg
NATO stock number: 1385-99-130-7103

Status
In production. In service with the UK MoD and worldwide.

Contractor
AB Precision (Poole) Limited.

ABL 2000 recoilless disruptor (Pommel)

Development
The ABL 2000 is a recoilless weapon designed to disrupt thin-walled improvised explosive devices (IEDs), while avoiding detonation of the suspect item. The disruption effect is equivalent to the well-established Pigstick disruptor (see separate entry).

Description
Capable of multiple firings and requiring minimum maintenance, the ABL 2000 can be used for training without detriment to its operational performance. The recoilless design enables it to be carried and fired from miniature remotely operated vehicles, while avoiding collateral damage when used in confined spaces such as aircraft.

The ABL 2000 is supplied as a complete kit in valise style holdall containing the barrel assembly, rear body (breech), water bottle, loading tool, cleaning brush and cleaning rod. Cartridges are supplied in multiples of 18, packed in an H83 container, complete with pistons, closure caps and polythene bags.

Specifications
Length: 450 mm
Main body diameter: 64 mm
Maximum body diameter: 78 mm
Weight: 3.2 kg
NATO stock number: 1385-99-132-8227

Status
In service with the UK Mod and worldwide.

Contractor
AB Precision (Poole) Limited.

ABL 2000 on stand (AB Precision) 1299219

ABL 2000 accessories (AB Precision) 1299217

ABL 2000 on Guardian MROV (AB Precision) 1299218

ABL 3000 Recoilless Explosive Ordnance Disposal Disruptor

Description
The ABL 3000 is a recoilless weapon designed to defeat devices such as those packaged in suitcases and other similar sized packages without initiating the explosive content.

Capable of multiple firings and requiring minimum maintenance, the ABL 3000 can be used for training without detriment to its operational performance. The recoilless design enables it to be carried and fired from miniature remotely operated vehicles, while avoiding collateral damage when used in confined spaces such as aircraft.

The ABL 3000 is supplied as a complete kit in a valise style holdall containing the barrel assembly. Cartridges are supplied in multiples of 10, packed in an H83 container, complete with pistons, closure caps and polythene bags.

Specifications
Length: 460 mm
Main body diameter: 78 mm
Maximum body diameter: 90 mm
Weight: 4.2 kg

Status
In production. Soon to enter service with UK MoD.

Contractor
AB Precision (Poole) Ltd.

Limpet Mine Disposal Equipment (LMDE)

Development
AB Precision's Limpet Mine Disposal Equipment (LMDE) was developed to disrupt thin-cased mines that have been placed underwater on the hull or structure of a target vessel/installation. Mines are generally attached by magnets fitted to the base and removal can be extremely hazardous when anti-handling devices are fitted.

Description
The LMDE consists of a barrel mounted in a stand. The stand is attached to the steel hull or structure using flotation magnets to ensure maximum adhesion. The device is diver-portable and has buoyancy blocks fitted to reduce the effective weight in water. In use it is loaded before entering the water and then positioned adjacent to the mine. It can be tilted and finely adjusted by the diver using a trunnion and sleeve, which forms part of the stand. An electrically initiated bridgewire cap cartridge fires a slug of water at the mine case and explosive filling to disrupt the mine before it can explode. The electrical supply to the cartridge is connected from an electric charger, positioned and activated on the deck of the ship or structure.

The complete unit comprises two precision stainless steel barrels, a stand assembly and accessories and is supplied in two cases. Cartridges are supplied in multiples of 20 packed in H83 containers. A lower charge, training cartridge can be supplied for diver training.

Specifications
Maximum operating depth: 30 m
Barrel material: stainless steel BS S 80
Case 1
weight: 15 kg
dimensions: 500 × 300 × 300 mm
NATO stock number: 1385-99-533-1203
Case 2
weight: 2.3 kg
dimensions: 500 × 300 × 100 mm
NATO stock number: 1385-99965-7250

Status
In service.

LMDE positioned on the stand with buoyancy blocks (AB Precision) 0074310

Contractor
AB Precision (Poole) Limited.

Mantis Disruptor

Development
Mantis was developed specifically to offer an Ultra Lightweight Disruptor capability which has a high probability of rendering an IED target safe whilst retaining as much forensic evidence as possible.

Description
Mantis operates using a common cartridge in service with other ABP equipment and as such the logistics and approvals processes for organisations operating a suite of ABP equipment are simplified by the requirement to hold only one ammunition type for their General Purpose Disruptors.

Mantis has been tested using impact measurement, radiography, high-speed photography and simulated targets to positively verify performance and comparative performance. Mantis is particularly suited to applications such as Special Forces operations where equipment weight and ease of deployment are paramount. Mantis is also particularly suited for use on small ROVs with limited payload carrying capability or to allow multiple weapons to be carried by a single ROV. Conventional deployment either manually or by ROV is of course also possible. Mantis is a single shot device, which is supplied 'piston in place' with a closure cap and breech. It is therefore self contained with no cleaning or ancillary equipment required and no armoury inspection/maintenance required.

Specifications
Weight: 859 g (loaded)
Length: 440 mm
Diameter barrel: 50 mm
Diameter breach: 75 mm
NATO stock number: 1385-99-724-7514

MANTIS deployed from Guardian ROV (AB Precision) 1299224

Status
In service.

Contractor
AB Precision (Poole) Ltd.

Needle disruptor

Development
The Needle disruptor has been designed to disrupt small improvised explosive devices (IEDs) such as parcels, envelopes and thin-walled packages. It has been extensively tested and the manufacturer claims a high probability of avoiding detonation or explosion of the suspect device.

Description
The Needle is a multi-shot device capable of many firings without distortion of the main body, and requires minimum maintenance. It is fired using a L2A1 Sound Unit fired from a remote position by means of a cable and Exploder Dynamo Condenser.

The disruptor fires a slug of high-velocity water which ensures maximum penetration. The unit can be used to train EOD personnel without detriment to its operational performance.

In use, the device is positioned using an anti-roll clamp or the supplied lightweight stand to ensure accurate placement. A nylon sleeve is provided to allow the disruptor to be used with a remotely controlled EOD vehicle. Preparation of the device can be carried out behind cover or away from the IED area to ensure operator safety.

The disruptor is machined from corrosion-resistant, precision machined parts and is supplied as a complete kit in a zipped canvas holdall. The kit

Needle shown mounted using lightweight stand and mounted on Cyclops ROV (inset) (AB Precision (Poole) Ltd) 1299215

contains a disruptor main body, disruptor rear body, split sleeve adaptor, loading tool, anti-roll clamp, cleaning brush and rod, stand, pistons and sealing sleeves.

Specifications
Weight: 875 g
Diameter:
main body: 22 mm
rear body: 34 mm
Length: 295 mm
Liquid fill: 13.5 ml water
NATO stock number: 1385-99-978-3446

Needle disruptor in service with the Lebanese armed forces (Colin King) 0074234

Status
In service with the UK MoD and other bomb disposal teams worldwide.

Contractor
AB Precision (Poole) Limited.

Pigstick EOD disruptor

Description
The Pigstick is an established and well-proven device for disrupting thin-walled improvised explosive devices (IEDs) by means of a high-velocity slug of water. It has been extensively used and has a high probability of avoiding detonation or explosion of the suspect article. A multi-shot device, it is capable of being fired many times without distortion of the barrel and requires minimum maintenance.

The disruptor is fired using a bridgewire cap cartridge fired from a remote position by means of a cable and exploder.

The Pigstick can be positioned by means of an anti-roll clamp or an optional lightweight stand, or can be easily fitted to a remotely operated vehicle.

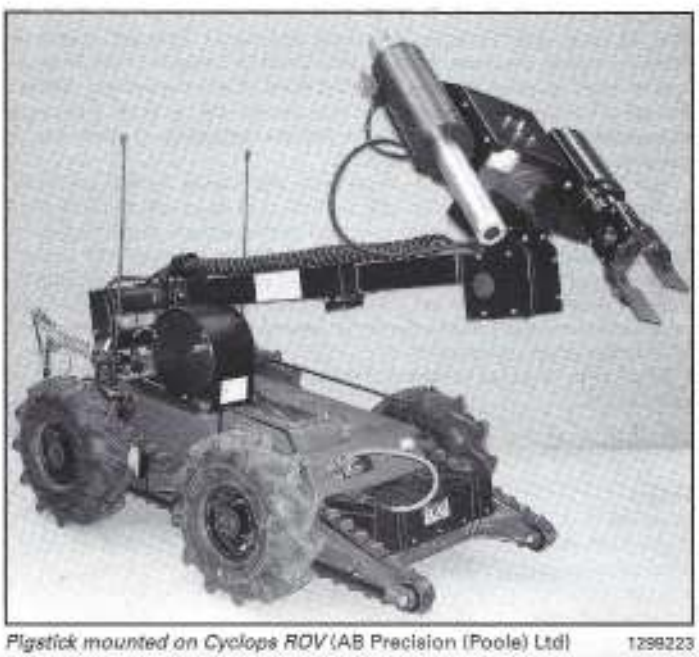
Pigstick is supplied in an olive green canvas holdall with stitched pockets, containing the injector barrel assembly, water bottle, loading tool, cleaning brush, screwdriver and anti-roll clamp.

Specifications
Barrel weight: 2.95 kg
Barrel length: 485 mm
Holdall size: 500 × 300 × 200 mm
Total kit weight: 4 kg
NATO stock number: 1385-99-207-8890

Status
In production and in service with the UK MoD and worldwide.

Contractor
AB Precision (Poole) Limited.

Pigstick kit components (inset) and positioned using the lightweight stand (AB Precision) 0074241



Pigstick mounted on Cyclops ROV (AB Precision (Poole) Ltd) 1299223

Boot Banger™ Mk4 projected water disruptor

Description

The Boot Banger™ Mk 4 is a user-filled, Vehicle Borne Improvised Explosive Device (VBIED) disruptor. It consists essentially of a water-lined shaped charge that is loaded with either sheet explosive or detonating cord. A Boot Banger™ is capable of removing several 155 mm shells from the boot of a vehicle.

The Mk 4 retains the same explosive and hydraulic geometry of earlier models but has been redesigned to be easier to use and deploy.

The charge is typically placed under a vehicle known or believed to contain a bomb. It may also be used as a breaching tool to open strong, exterior doors.

The Boot Banger™ Mk 4 uses a patented technology (US Patent 6,584,908 & others) to deliver a shaped charge using sheet explosive or detonating cord as the propellant and water as the projectile.

The forward container is the projectile, which has a cross section shaped like a half-moon. The convex face fits inside a corresponding cavity in the second vessel, with the explosive sandwiched between the two. The larger, rear component acts as a tamper for the explosive and increases the proportion of energy imparted to the projectile. When actuated, the Boot Banger™ projects a jet of water with such force that the bottom of the vehicle is penetrated and the bomb ejected through the boot lid or the roof. Detonating cord is severed by the jet without initiation.

The device is provided empty and is loaded by the user with explosive and water. The case is 110 mm deep to allow it to be placed under a vehicle, even when the tyres have been deflated. The loaded device is light enough for manipulation by small vehicles. No metal is used in the construction of the device so few fragments are projected. The explosive is contained by water on all sides.

Specifications

Dimensions: 460 × 340 × 110 mm
Weight:
full: 16 kg
empty: 2.3 kg
Total water: 15.5 litres
Net Explosive Quantity (NEQ):
225 g mm of sheet explosive
250 g single layer of 10 g/m detonating cord
450 g C2
675 g SX2

Multiple layers of sheet explosive can be used to give much heavier loads if required.

Status

In production and in use in Iraq and Afghanistan.

Contractor

Alford Technologies.

Boot Banger™ (Alford Technologies) 1154609

Boot Banger™ Mk 4 in operation (Alford Technologies) 1194960

Bottler® Mk 2 jacketed explosive disruptor

Description

The Bottlers are a family of omni-directional jacketed explosive disruptors. They are powerful disruptors used for defeating Vehicle Borne Improvised Explosive Devices (VBIEDs) from within the vehicle, without the risk of causing fires. The devices may also be used as omni-directional disruptors for IEDs such as roadside devices consisting of shells cast in concrete and other, soft-skinned, IEDs.

The Bottlers are provided empty and are loaded by the user with explosive and water, sand, or with a mixture of sand and salt. The Mk 2 Bottlers have been completely re-tooled to make them much simpler to load and their dimensions have also been slightly changed. The Bottlers are designed to use military or commercial electric detonators, or shock tube detonators, as well as Detonating Cord Boosters (DCBs). Shock tube detonators are suitable for firing several Bottlers Mk 2 in very rapid succession or simultaneously.

Three sizes of outer container are available: nominally 1 litre, 500 ml and 250 ml.

Specifications

	250 ml	500 ml	1 litre
Height	125 mm	150 mm	200 mm
Diameter	60 mm	80 mm	100 mm
Water content	195 ml	550 ml	1,200 ml
Maximum loaded weight:	340 g	778 g	1.55 kg
Approximate net explosive quantity:	20–110 g	20–140 g	20–200 g

Bottler in place (Alford Technologies) 1154608

Status

In production and in use in countries such as Iraq and the US.

Contractor

Alford Technologies.

DemiMod®, MiniMod® and MajorMod® recoilless projected water disruptors

Description

The DemiMod, MiniMod and MajorMod are a family of small- and medium-sized modular, water projecting, linear shaped charges which make use of detonating cord or sheet explosive as propellant. They are highly directional and very powerful and all share the same essential geometry (also shared by the Bootbanger, MLVD and Vehicle Borne Improvised Explosive Device (VBIED) disruptors), but vary in size and length to suit different needs.

Each module consists of two elongate plastic containers of water of which one, the projectile, has an approximately half-moon shaped cross section. The convex face fits inside a corresponding cavity in the second vessel, with the explosive sandwiched between the two. The larger, rear component acts as a tamper for the explosive and increases the proportion of energy imparted to the projectile. On firing, the projectile travels forward like a high-speed blade of water. The DemiMod has the same cross section as the MiniMod but has half the length, while the MajorMod is a half-length MLVD.

Each module is provided with two end caps which hold the projectile/explosive/tamper sandwich together. Each pair of end caps can be clipped onto one or two similar pairs on adjacent modular charges to make a parallel array. Alternatively, a pair of charge modules can be joined end-to-end, so as to constitute an elongate charge. For combat EOD, where weight and size are important, the end-caps may be discarded and the modules fixed with tape.

The low weight of the charges make them suitable for deployment by small, remote-controlled vehicles or by hand.

Specifications

DemiMod
Dimensions: 170 × 70 × 60 mm
Weight (empty): 200 g
Weight (full): 500 g
Net explosive quantity (min): 4.5 g
Net explosive quantity (max): 20 g
Volume of water projected: 0.1 litres

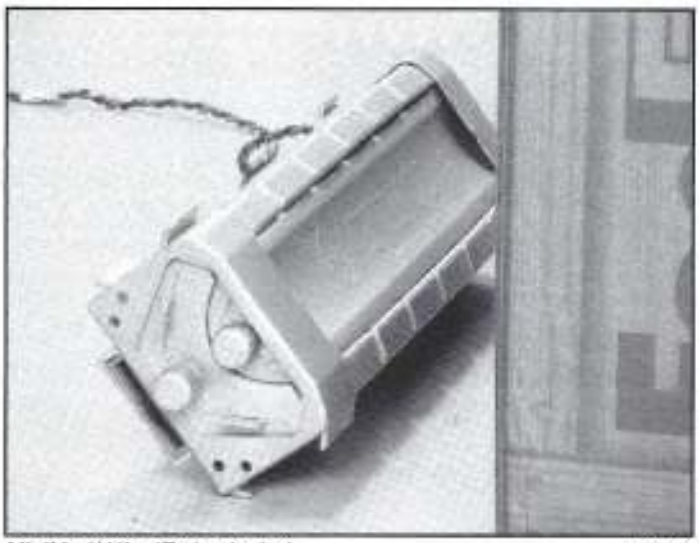
MiniMod
Dimensions: 300 × 85 × 60 mm
Weight (empty): 180 g
Weight (full): 900 g
Volume of water projected: 0.2 litres

Status

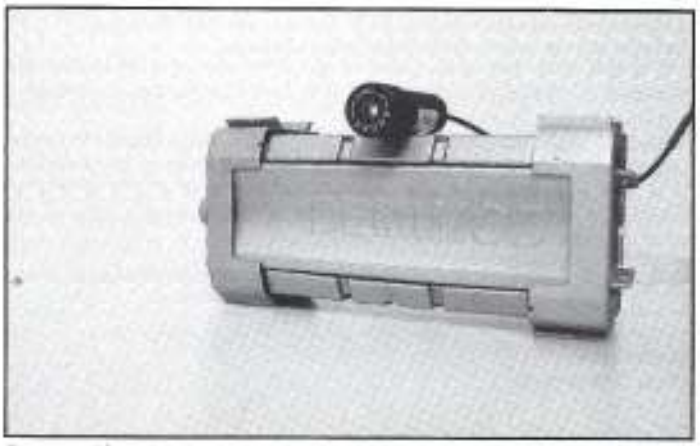
Available.

Contractor

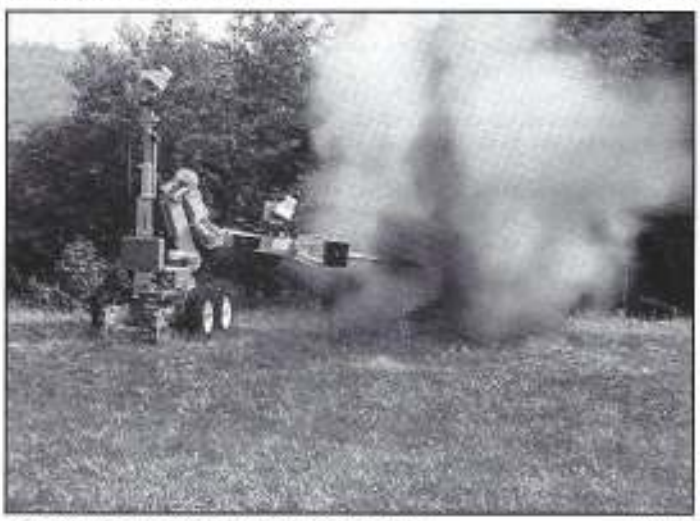
Alford Technologies.



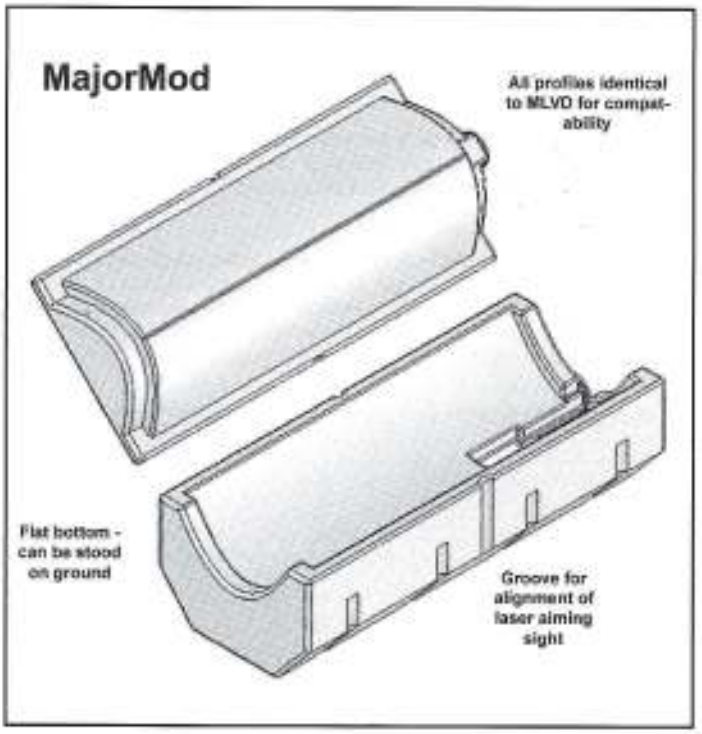
MiniMod (Alford Technologies) 1154603



DemiMod (Alford Technologies) 1194961



DemiMod in operation (Alford Technologies) 1194962


MajorMod
All profiles identical to MLVD for compatability
Flat bottom - can be stood on ground
Groove for alignment of laser aiming sight

MajorMod in outline (Alford Technologies) 1154604

Krakatoa® large point-focal, explosively formed projectile shaped charge kit

Description

Krakatoa® is a highly versatile and modular user-filled charge container for EOD and demolition both in air and underwater and replaces the Bigjet (MEPS) which has been in service for a number of years. The new model has significant design improvements aimed at enhancing both performance and applicability, both in terms of modularity and user friendliness.

The charge may be used in a horizontal orientation with such projectiles as the copper EFP and the Gladius, or vertically with the copper Jet Forming Cone. The charge container body is approximately 100 mm in diameter and 100 mm in length. There are two positions for the projectile, giving two standard loads, one of approximately 500 g and the other of 1,000 g of plastic explosive.

It is screw-consolidated and able to accept a range of projectiles for a variety of possible applications. The sighting arrangement on the body accepts a red dot aiming device for longer-range, stand-off attack. It can also receive sights and accessories fitted with the Picatinny rail which is supplied as part of the kit. The Krakatoa® basic kit is supplied with three charge bodies, a loading kit and a sight. The user then selects the projectile for the intended application. An underwater capsule may be fixed to the front of the charge to allow it to be used underwater.

Available projectiles
The Krakatoa® system is evolving and new projectiles and accessories will be added by the manufacturer as and when requirements arise. There are currently three projectiles available:

EFP charge The Explosively-Formed Projectile (EFP) charge (Charge Kit, Demolition, Fragment, Self-Forging, L70A2) has a slightly indented copper charge liner which is able to produce a hole of ~40 mm diameter in 30 mm steel plate at a 30 m stand-off range.

It may be used as a stand-off tool to high-order thick-skinned munitions that are too difficult or too dangerous to approach. When used in conjunction with the underwater capsule, the EFP may be used as a diver-placed charge to deliberately high-order a sea mine in order to clear a waterway rapidly.

Jet Forming Charge The Jet Forming Charge (Charge Kit, Demolition, Projector, L71A2) has a conical copper liner which is able to penetrate ~250 mm mild steel with a hole diameter of ~18 mm. In this respect it is comparable with the obsolete UK Charge, Demolition No1 (CD1 – 6" Beehive) though much more explosively efficient.

This projectile has been used as an EOD disruptor. However, the manufacturer believes that the EFP is likely to prove a more effective projectile for this application.

Gladius projectile The Gladius (Charge Kit, Demolition, Projector, L72A2) has a plastic container holding 480 steel balls as its projectile. These are projected at a higher velocity and in a more highly collimated distribution pattern than those from the M18 Claymore mine, whose effect it replicates.

Status
Available.

Contractor
Alford Technologies.

Krakatoa® (Alford Technologies) 1154606

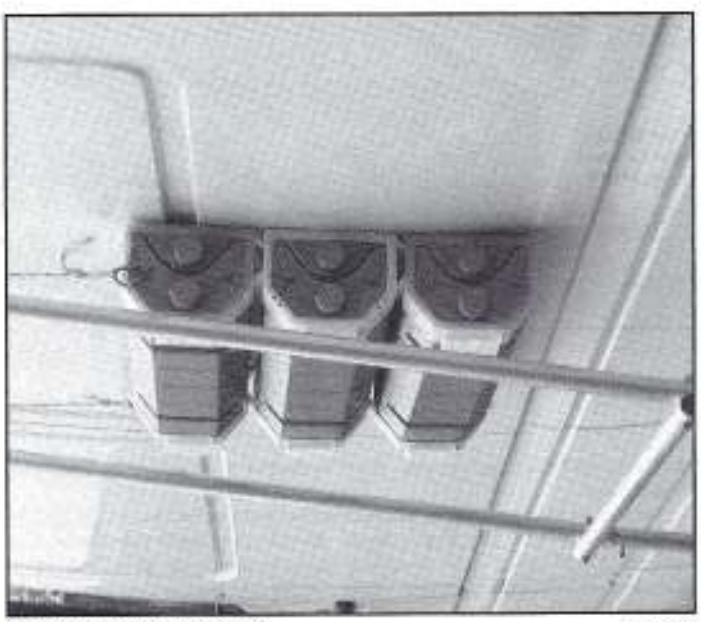
MLVD® Mk 2 water projecting disruptor

Development
The MLVD was conceived as a modular, water-projecting, linear shaped charge disruptor for both side attack or placement beneath a vehicle. The tool has now been completely redesigned so that it is totally modular.

Description
The MLVD Mk 2 is provided in sets of three modules which, used together, replicate the Mk 1 device. Single modules or a multiplicity of modules (typically between two and four), which can be quickly conjoined, are used as disruptive charges best matched to the target. In such configurations, the manufacturer claims the MLVD to be the most powerful vehicle-disrupting charge for Vehicle Borne Improvised Explosive Devices (VBIEDs) that is truly man-portable.

Each module consists of two elongated plastic containers of water of which one, the projectile, has an approximately half-moon shaped cross section. The convex face fits inside a corresponding cavity in the second vessel, with the explosive, which may be sheet explosive or detonating cord, sandwiched between the two. The larger, rear component acts as a tamper for the explosive and increases the energy imparted to the projectile.

Each module is provided with two end caps which hold the projectile/explosive/tamper sandwich together. Each pair of end caps can be clipped onto one or two similar pairs on adjacent modular charges to make a parallel array. Alternatively a pair of charge modules can be joined



MLVD (Alford Technologies) 1194963

MLVD in operation (Alford Technologies) 1194964

end-to-end so as to constitute an elongate charge approximately equivalent to Alford Technologies' Exit system in size and disruptive power. The Exit has thus been rendered obsolete.

The MLVD can also be used for breaching. Single modules may also be used to breach doors and walls.

A light, ROV-deployable stand is now available for supporting the MLVD. The stand can suspend a full MLVD against the side of a vehicle with the bottom charge virtually at ground level up to a maximum height of 1.65 m.

Specifications

Per module
Size: 570 × 150 × 120 mm
Weight (full): 5.5 kg
Total water content: 4.0 litres

Array of 3 modules
Size: 570 × 450 × 120 mm
Weight (full): 16.5 kg
Total water content: 12.0 litres

Explosive loads
1 module: Minimum – 145 g, Maximum – 720 g
2 modules: Minimum – 290 g, Maximum – 1.44 kg
3 modules: Minimum – 435 g, Maximum – 2.16 kg

Status

In production and in service in countries such as Iraq and the United States.

Contractor

Alford Technologies.

RE 12g Mini Disrupter

Description

The RE 12g Mini is a mini modular recoilless Disrupter. The cannon is powered by an electrically initiated 12 gauge cartridge and features a 19 mm bore barrel. The Disrupter can be used with either a water charge, frangible or solid projectile with a mass of 50 g.

The Mini Disrupter can be supplied equipped for firing either electrically or by ShockTube.

The system utilises the RE 70 series Multi-Position Stand and Sights. These features enable the Disrupter to be used, when necessary, with a stand-off from the target when using frangible or solid projectiles.

Specifications

Dimensions
Transit case: 610 × 325 × 213 high mm
Length (overall): 345 mm
Overall diameter across compensator: 78 mm
Weights
Cannon on its own: 1.10 kg
Cannon in stand: 6 kg
Complete equipment in transit case: 10.5 kg
NATO stock number: 1385-99-340-2191

Status

In production and in widespread service.

Contractor

Richmond EEI Limited.

RE 12 g Mini Disrupter mounted on upper arm (and RE 70 M3 Plus Disrupter mounted on middle arm) of iRobot Pakbot. (Richmond EEI Ltd) 1293451

RE 70 M3 Plus De-armer Disruptor

Description

The RE 70 M3 Plus is a modular, totally recoilless de-armer and disruptor. This model features both 25.4 mm (1 in) and 40 mm barrel formats. The tool can be configured either as a de-armer for firing a range of solid projectiles or a disruptor for firing a range of fluid and frangible projectiles. The RE 70 M3 Plus can be deployed either close up to the target in the conventional way or with a significant stand off. The purpose of the stand-off capability is to lower the threshold of danger to an operator who is manually placing the de-armer disruptor, or a robotic vehicle which is carrying it.

When deployed with a stand off, the RE 70 M3 Plus is used in conjunction with an Elastomer or a spin-stabilised frangible projectile in the disruptor role or with a spin-stabilised plain slug projectile in the de-armer role. The tool is powered by electrically initiated .50-calibre power cartridges and fires projectiles with a mass of up to 290 g (10 oz).

Specifications

NATO Stock Number: 1385 99 134 3601

Status

In production, entered service with US forces in 2002 and used by most NATO countries, including UK.

Contractor

Richmond EEI Limited.

RE 70 M3 Plus De-armer Disruptor (Richmond EEI Ltd) 1293449

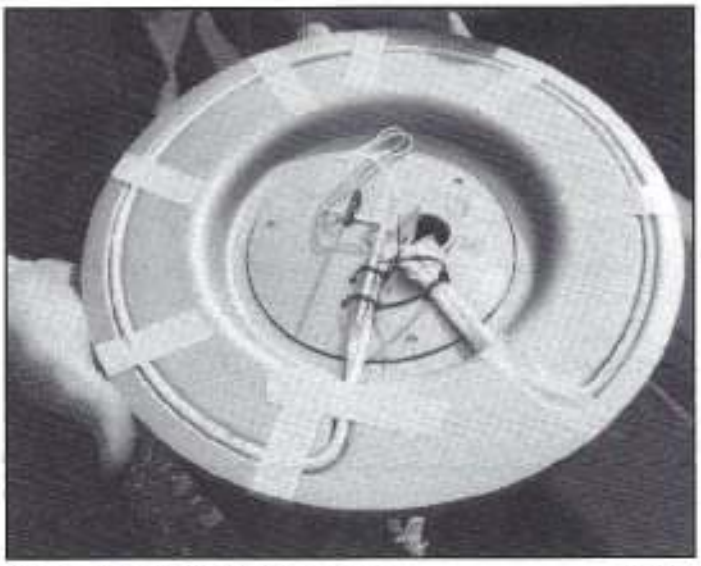
Van Trepan™ Mk 3 explosive trepanning tool for vehicles

Development

The Van Trepan™ is a lightweight plastic charge case which is loaded with explosive by the user. It is designed to cut inspection holes in the side, door or roof of a vehicle suspected of containing a Vehicle Borne Improvised Explosive Device (VBIED) prior to deployment of a disruptor such as the Alford Technologies MLVD or inspection of the contents of the vehicle.

Description

The Van Trepan™ is a user-filled, water-tamped cutting charge, the explosive being placed directly in contact with the target. Tamping the explosive greatly enhances the cutting power, while decreasing the blast and flash. The light loads used in the Van Trepan™ mean that it hardly



Van Trepan™ Mk 3 (Alford Technologies) 1334732

disturbs the target vehicle, making it unlikely to set-off booby-traps or tilt switches. It may be deployed by small, remote-controlled vehicles that need minimal protection when the charge is fired. The Mk 3 is produced in a softer plastic than earlier models to reduce the production of dangerous fragments which are less likely to damage a robot (if deployed).

The charge case is made from a circular plastic moulding with a groove on the target-contact surface. This is designed to receive one or two broken loops of detonating cord, with a typical load of about 11 g per loop. A semi-circular sectioned cavity runs behind the detonating cord and is filled with water before firing. The advantage of cutting a major arc of the target structure rather than a complete circle is that the cut metal is not projected directly forward, where it might strike a VBIED but, instead, hinges across the uncut arc and is deflected to one side where it is less likely to produce a harmful effect.

The charge is normally held against the target by the remote-controlled vehicle, this allows the vehicle to approach and immediately insert a camera into the hole created for rapid target identification however, magnets can also be used to attach the charge to ferrous targets.

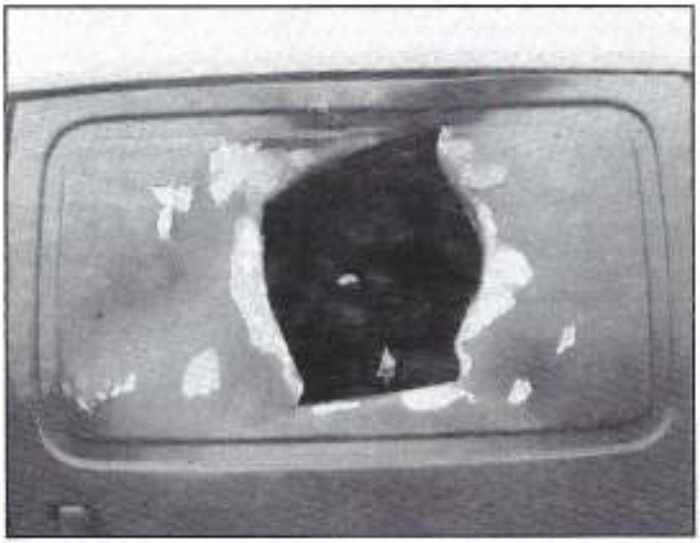
When loaded with a single loop of 10 g/m detonating cord, the Van Trepan™ cuts a hole approximately 300 mm in diameter through 0.9 mm steel sheet.

Specifications

Diameter: 370 mm
Height: 20 mm
Weight, empty: 400 g
Volume of water: 530 ml
Total weight: 930 g
Net Explosive Quantity (NEQ):

11 g	single loop 10 g/m detonating cord
22 g	double loop 10 g/m detonating cord

Van Trepan™ Mk 3 (Alford Technologies) 1194965



The Van Trepan™ cuts a hole approximately 300 mm in diameter through 0.9 mm steel sheet (Alford Technologies) 1334733

Status

In production and in service.

Contractor

Alford Technologies.

Vulcan® small point-focal and explosively formed projectile shaped charge kit

Description

Vulcan is a small, user-filled, point-focal, shaped charge system. The charge containers are made from plastic, and the user can choose from a range of different projectiles, which may be used to obtain different results. Explosive loads vary between 5 and 50 g, according to application.

As it is completely inert, the Vulcan may be transported and stored without any special conditions, which makes it highly suitable for rapid deployment worldwide. In its primary role, as a low-order tool for conventional munitions, the Vulcan has an excellent record of successful interventions against live, air-dropped munitions, both in air and underwater.

Vulcan charges are supported by aluminium wire legs that can be formed into a bipod or tripod; the devices may also be laid directly on the ground. A lightweight aluminium tripod is also available. No precautions against recoil are required.

The detonator well is sized to take the British L2A1 and L2A2 and US M6 detonators as well as the L10 Detonating Cord Booster (DCB). It can also accept commercial detonators and shock-tube initiators. The system can be adapted to accept other military and commercial detonators as required. All detonators are held by a universal detonator holding screw.

Vulcan forms the basis of the Vulcan Limpet Mine Neutralisation System (see separate entry).

Vulcan (Alford Technologies) 1194967

Magnesium incendiary cone
The jet formed by this cone is less penetrating than that formed by a copper cone, but is a less powerful initiator of detonation. It is used to penetrate even thick-walled shells or bombs and ignite the explosive or pyrotechnic filling. In this application, it is much less likely to cause inadvertent high-order detonation than other, more conventional, charges, thus providing a reliable means of bringing about a low-order deflagration event in air or underwater. The usual explosive load is 30 to 40 g.

Copper cone
The jet-forming copper cone can be used to pierce holes, typically through 100 mm of mild steel, or greater thickness of concrete or brickwork. It may be used to cause the detonation or deflagration of steel-cased ammunition without the risk of inadvertent disturbance of the target. The usual explosive load is 20 to 50 g.

Copper explosively-formed projectile
A wide-angled copper cone that generates an Explosively Formed Projectile (EFP). It may be used to penetrate robust targets at much greater ranges than the jet-forming cone. This enables the Vulcan to be used as a de-armer and disruptor device. It penetrates 10 mm thick steel at a range of at least 1.5 m.

ABS cone (ABS/water composite projectile)
The ABS cone is used with water as a composite projectile. A conical cavity is formed in the explosive, water is poured into the cavity and the ABS cone is inserted to retain the water. The charge then becomes a shaped charge, able to penetrate steel-cased munitions with wall thickness of up to 10 mm. Thin-cased munitions are split open and their contents dispersed with minimal risk of detonation.

Aluminium EFP
The aluminium projectile is able to deliver a powerful blow to shell fuses and bomb pistols, removing them or jamming their mechanisms.

Nozzle
An elongate plastic cone that fits onto the open end of the Vulcan body assembly. This provides a pressure-resistant stand-off space enabling the device to be used underwater. The nozzle also allows the charge to be accurately aimed.

Trepanning attachment
The Vulcan body can be fitted with a trepanning attachment that enables the charge to cut a disc approximately 37 mm in diameter in a munition case for inspection or flooding.

Water jacket
The flash generated by Vulcan can be largely suppressed by the use of the water jacket.

Underwater stand-off capsule and latex sleeve
The original underwater stand-off capsule, which required a latex sleeve to render it waterproof, has now been replaced by a new, flat-ended capsule that fits onto the front of the body. It is there secured by a threaded, consolidated ring. This component has been so designed that an O-ring suffices to assure it is water-tight. The assembly constitutes the disruptor of the new Vulcan Limpet Mine Neutralisation System (see separate entry).

Specifications
NATO stock no: 1385-99-833-2491

Status
In production and in service in countries such as Afghanistan, Iraq, Laos, the UK and Vietnam.

Contractor
Alford Technologies.

Vulcan Limpet Mine Neutralisation System (LMNS)

Description
The Vulcan® Limpet Mine Neutralisation is a new system built around the Vulcan® disruptor. The system is designed to give operators a complete set of tools with which to defeat multiple mines simultaneously. Prototype systems have been fielded in a number of theatres and the system is still under development.

The benefits of the Vulcan®, such as simplicity of loading, modularity and small size are even more notable in water than in air. The Vulcan® System underwater capsule has been redesigned with an improved seal, and a new, highly modular, stand has also been created. The stand, which is made from plastic, can be assembled in various ways to allow different configurations of disruptors to be used single or dual, and simplified for training use. The light weight of the Vulcan®, and its small size, allow the stand to be kept small and easy to swim with. The stand comes with powerful magnets – alternative attachment modules are also under development by the manufacturer. The system comes in a rugged Pelican case and contains only inert items; this allows systems to be rapidly deployed anywhere in the world. The system may be restocked as and when elements are used, so that it is always in a state of readiness.

The Vulcan® has undergone extensive trials against known mines with success, and is capable of defeating modern mines with multiple anti-lift switches. Arrays of Vulcans® may be deployed and fired simultaneously to defeat multiple mine attacks. The tool also offers a good response to improvised mines.

Status
Available.

Contractor
Alford Technologies.

Vulcan® LMNS (Alford Technologies)
1154599

United States

Disruptor cannons and accessories

Description
Royal Arms International manufactures a range of precision engineered disruptor cannons, kits and accessories.

The range includes the RADC-2 kit, which comprises an RADC-2 disruptor, laser sight, inline and water laser holders, push rod, electric and shock tube igniters, cable reels and a variety of ammunition. The RADC-2/D dual kit contains two cannons, breach bolts, inserts, sights and water holders, along with other accessories.

A range of stands are available including:

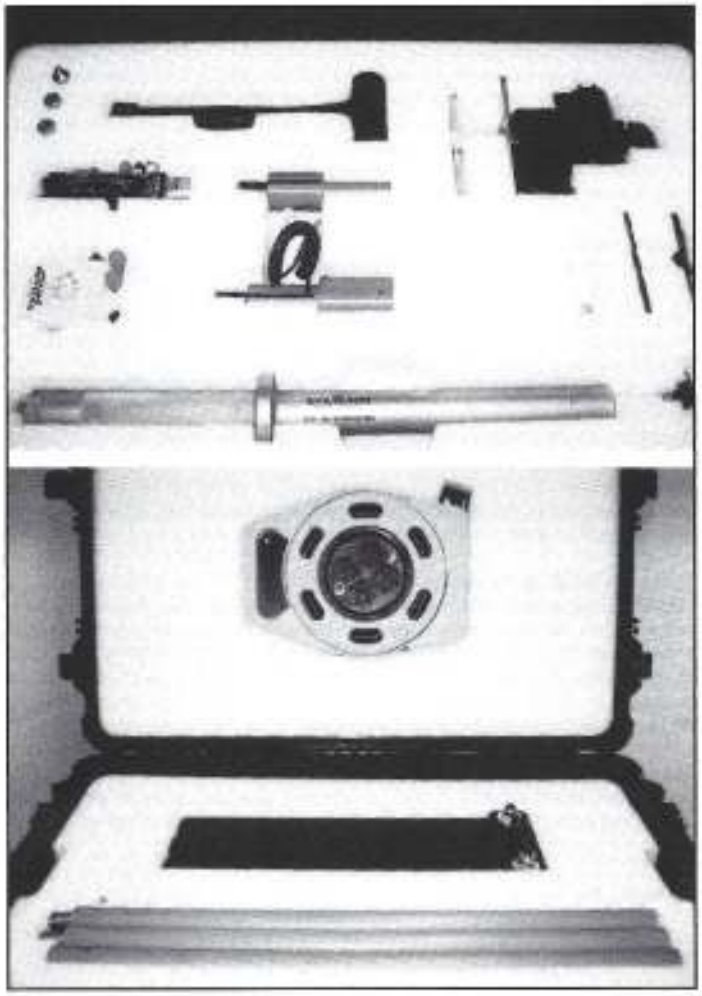
- DCS fully collapsible and adjustable stands with no tools needed for setup;
- RADC-BS bag stands for use with 18 in or dual cannons; and

- Poly Stands made from 12.5 mm thick polycarbonate that allow quick and easy placement of cannons on improvised explosive devices (IEDs).

Other accessories include a backpack, cleaning/extraction kit, laser sight holders and shock tube kit.

Status
No longer in production. Has been replaced with the RADC-18X.

Contractor
Royal Arms International.



RADC-2 disruptor cannon kit (Royal Arms International)
1041236

RADC-18X Royal Arms 18 in Disrupter Cannon

Development
Royal Arms International manufactures a range of disruptor cannon, kits and accessories.

Description
The range includes the newly redesigned RADC-18X 18 in disrupter cannon with external acme breech.

RADC-18X disrupter cannons are machined from 17-4 Stainless Steel and have a precision gun drilled to .730 in which is prepared to a mirror finish for improved accuracy/velocity and ease of cleaning.

The chamber is 3.5 in to accept high power loads and all commercial 12 gauge.

The welded body ring is milled flat on the bottom to prevent rolling while on ground. When placed in a stand, the body ring holds a positive lock up to reduce rear flight.

Self aligning locator hole for accurate laser placement.

Specifications
Length: 18 in
Weight: 8.25 lbs
Diameter: 1.5 in

RADC-18X Royal Arms 18 in Disrupter Cannon (Royal Arms International)
1299213

Status
In production and in service.

Contractor
Royal Arms International.

EXPLOSIVES, PYROTECHNICS AND DEMOLITION ACCESSORIES

Austria

EOD System

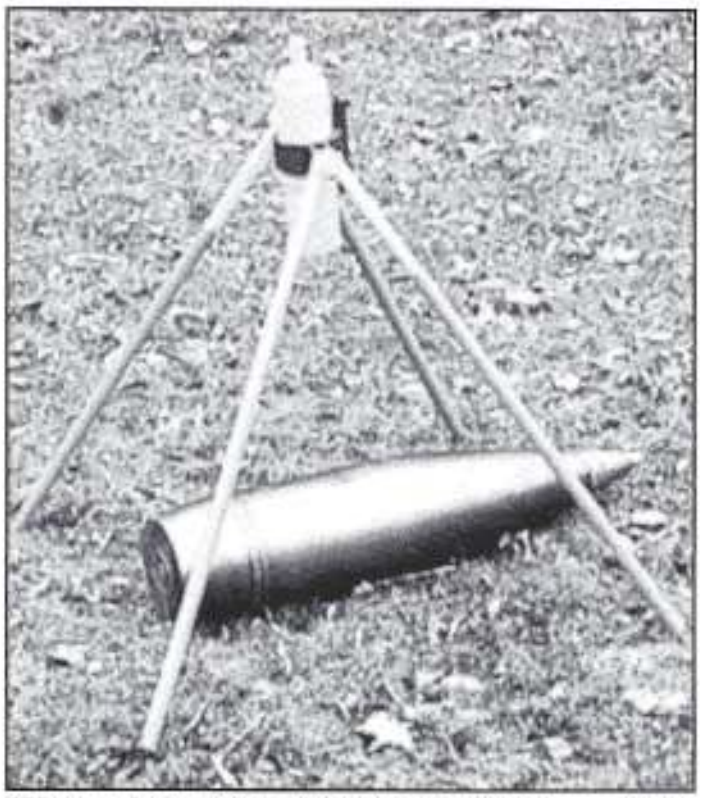
Description
The DNW EOD System comprises two different charges: for detonation (red) or deflagration (yellow). Both charges have a rugged plastic case, the front end of which is a hollow cup. This cup indicates the minimum stand-off and for underwater work, the cup provides the medium required for the development of the penetration jet. Both charges are equipped with four swivelling legs and an add-on peep back sight, enabling safe and stable positioning and precise aiming of the charge. Initiation is achieved either electrically or pyrotechnically, with a no 8 detonator.

On activation of the red (detonation) charge a hyper-velocity jet of a high-precision shaped charge penetrates the shell of the unexploded ordnance (UXO) and results in a full-scale detonation of the explosive. A non-metallic version (with glass liner) is available for use against magnetic influence fuzed mines.

The much slower yellow charge also penetrates the shell but in most cases the result is the deflagration of the explosive content, with a correspondingly reduced potential for danger.

Specifications
Length: 240 mm
Maximum diameter: 75 mm
Total weight: 600 g
Explosive weight: 450 g Composition B
Maximum standoff distance: 3 m (yellow)
Penetration (steel St 37):
red: 200 mm
yellow: 40 mm
Entry diameter of penetration:
red: 10 mm
yellow: 30 mm
Operating temperature: –30 to +60°C
Packing: 15 charges per wooden case

Status
Believed to be in service with Western European armed forces.



EOD system for detonation or deflagration of UXO (DNW) 0074423

Contractor
Dynamit Nobel Wien GesmbH.

Metal-free Destroying Charge 97

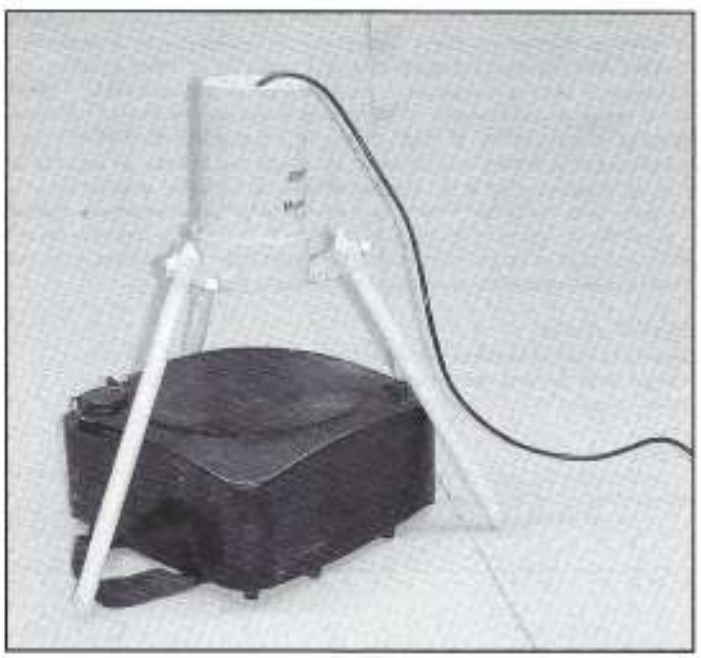
Description
This metal-free shaped charge is intended for many EOD purposes, especially against magnetic influence fuzed mines, which are metal sensitive.

The device can be used against UXO on the surface or buried at depths up to 350 mm. The device is positioned over the target using the tripod and initiated using an electrical detonator or a blasting cap and time-delay fuse.

The Destroying Charge 97 comprises the charge in a plastic housing, a tripod and a standoff tube; all parts are completely metal-free.

Status
In production.

Contractor
Intertechnik Technische Produktionen GmbH.



The metal-free Destroying Charge 97 is suited to magnetic influence fuzed mines (Intertechnik) 0077530

Canada

FIXOR™

Description
FIXOR™ is a binary explosive designed for the neutralisation of mines and unexploded ordnance (UXO) through sympathetic detonation.

The system is comprised of two plastic bottles, one containing a Class 3 flammable liquid (same class as gasoline), the other containing an inert powder. When the liquid is poured into the bottle containing the powder and the bottle is shaken sufficiently to form a smooth, consistent solution, a detonator sensitive FIXOR™ explosive is formed.

MREL maintains a FIXOR™ website (www.fixor.comwww.fixor.com) containing a database of proven render safe procedures (RSP) for named ordnance.

FIXOR™ liquid is classified Class 3 Flammable Liquid UN 2842, Packing Group III (30°C c.c.) while the powder has no hazard classification.

Specifications

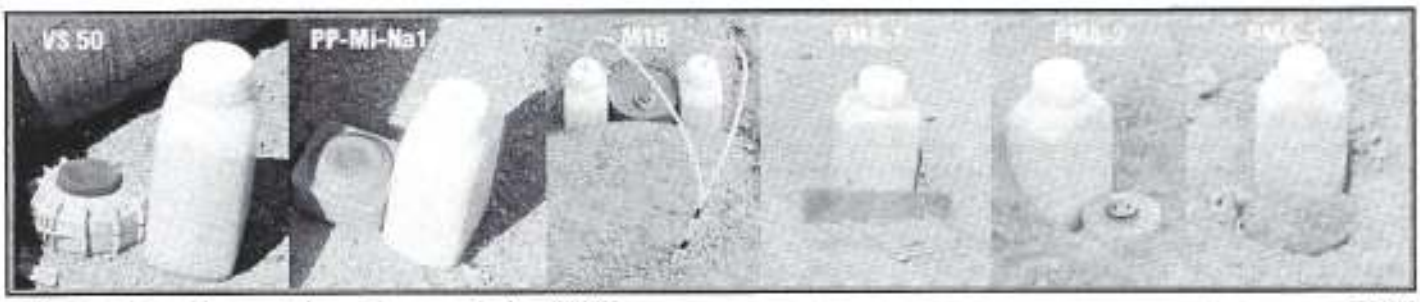
FIXOR™ Explosive
Classification: Class 1.1D explosive. Charges, demolition UN 0048
Net explosive weight: 400 g
Colour: orange
Density: 0.9 g/cc
Velocity: 4,300 m/s
Operational temperature: –40 to +65°C
Operational time: detonate within 2 h of mixing, or remix by shaking before detonating
Shelf life: 7 years when stored to manufacturer's specifications
Initiation: ULI knotted 50 grain/ft detonating cord or detonator with a minimum 0.8g base charge

Status

In production. In use in many locations including Armenia, Azerbaijan, Cambodia, Congo-Brazzaville, Eritrea, Ethiopia, Mozambique, Nicaragua, Rwanda, Somalia, Thailand, Zambia

Contractor

MREL Group of Companies Limited.



FIXOR™ positioned for use against anti-personnel mines (MREL) 0074430

FIXOR™ positioned for use against anti-tank mines (MREL) 0074431

AquaRam™ Max Tactical Disrupter

Description

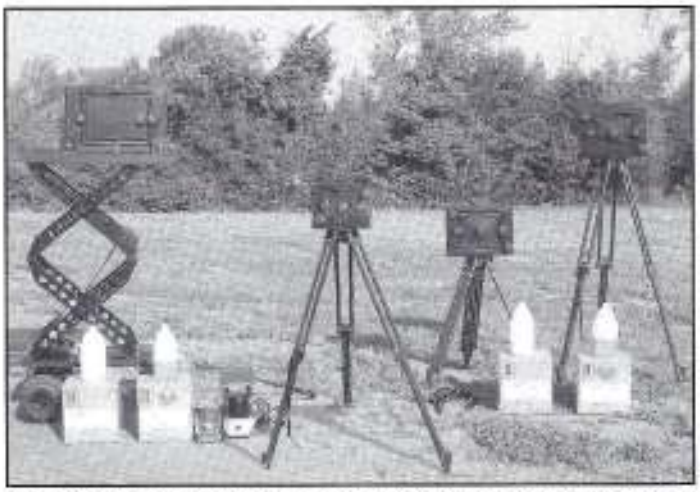
MREL has created the AquaRam™ Max Tactical Disrupter, a system that utilises directional explosively driven water to disrupt the contents of vehicles containing large quantities of explosives in a controlled manner with minimal collateral effects. Compared to other systems, the AquaRam™ Max is unique in three attributes: it contains BSM™ blast/flame suppression material to significantly reduce the risk of collateral damage in the vicinity of deployment; it is supplied with FIXOR™ (see separate entry) binary explosive to eliminate the burden of explosives storage logistics; and it is of a realistically and rapidly deployable size whereby one AquaRam™ Max can be robot or hand-deployed against a small panel van and multiple AquaRam™ Max units simultaneously deployed against larger vans and trailers within the operational response time typically available to responding bomb technicians.

Specifications

Size, fully loaded in robot deployment position: 119 × 57 × 97 cm
Weight, fully loaded and mounted on deployment system: 155 kg
Power supply: 12 V DC rechargeable battery

Status

In production. In service with military forces in Afghanistan and civilian law enforcement in Canada and United States.



MREL Speciality Explosive Products (MREL) (from left to right) AquaRam™ Max; AquaRam™ Micro and AquaRam™ Mini (MREL) 1198626

Contractor

MREL Group of Companies Limited.

Czech Republic

PN-50 shaped charge

The PN-50 shaped charge is intended for special blasting works, EOD operations and booby trap destruction. Firing is achieved by means of electric or non-electric detonators, which are placed in the detonator cavity. The charge case is made from polyethylene and stand-off firing is achieved using a supplied wire stand. The set also contains fixing screws and a base, which is used as a ruler.

PN-50 is designed to have a good penetration/explosive weight ratio and to not produce dangerous fragments. This makes the charge suitable for the disposal of booby traps in urban areas. The charge penetrates homogenous armour (950 Mpa) to a depth of 120 mm.

In October 2003 VTUVM Slavicin Division became a division of VOP-026 Sternberk, s.p.

Specifications

Weight: 90 g
Diameter: 32 mm
Length: 54 mm

Explosive type: HMX
Explosive weight: 45 g

Status
No longer in production.

Contractor
VTUVM Slavicin Division.

PN-50 ready to fire
(VTUVM)
0074453

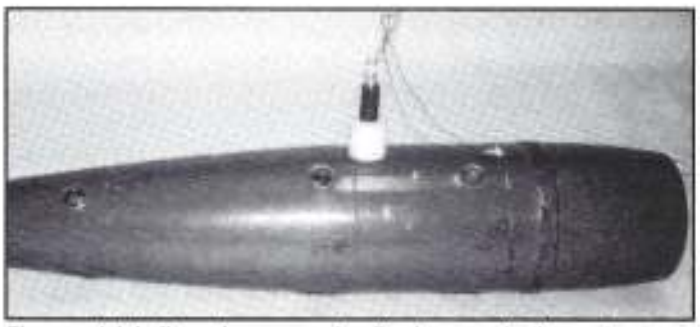
Special hollow charges

These charges are designed for destroying or testing of ammunition (live-inert) in the field, or as charges for demolition works and EOD operations. Either electrical or non-electrical detonators can be used for initiation. The charge is fixed to the target by way of a magnet or by an adhesive textile band. The charge can also be used underwater.

When used on live ammunition the charge causes a high order detonation; with inert or training ammunition inspection of the contents is possible.

Status
In production.

Contractor
VTUVM Slavicin Division.



The special hollow charge can be fixed magnetically to the target
(VTUVM)
0529581

Germany

BLASTER ignition set

Description
The BLASTER firing system consists of two high performance blasting machines, as well as extensive accessories for igniting telerob bomb disposal devices, cartridges, explosives and special charges. It employs non-battery-powered generation of current, with a wide output spectrum. The unit includes ohm meter and ignition cable drum, contained in a plastic case.

Specifications
Dimensions, when deployed
length: 25 cm
height: 10 cm
width: 10 cm
Dimensions, when packed
length: 46 cm
height: 19 cm
width: 32 cm
Weight, when deployed: 5 kg
Weight, when packed: 12 kg

Status
Available.

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.

BLASTER components (telerob)
0077659

Demolition kit

Description
This demolition kit from Force Ware contains a range of equipment housed in a rigid transport case and with an additional black Cordura nylon carrying case.

The set includes: EDK-700 and EDK-400 electronic blasting machines (see separate entry), battery charger, Victorinox Swiss Tool (see separate entry), cap box for 12 caps, plastic cap box, digital galvanometer, cap crimper and wire reel containing 500 m of firing wire. The complete demolition kit weighs 19 kg.

Status
In production.

Contractor
Force Ware GmbH.

The demolition kit is supplied complete with a transportation case
(Force Ware)
1041284

EDK-700 electronic blasting machine

Description
The EDK-700 is designed for use with electrically initiated detonators. The set is housed in an ABS plastic casing and is supplied complete with a recharger.

Specifications
Ignition voltage: 400 V DC
Ignition circuit capacity: 100 µF
Maximum net resistance: 400 Ω
Battery voltage: 9.2 V DC
Battery capacity: 1 Ah
Power supply: Motorola NTN 5521, min 9.2 V DC
Dimensions: 180 × 65 × 45 mm
Weight: 520 g
Temperature range: –20 to +70°C

Status
In production.

Contractor
Force Ware GmbH.

EDK-700 (Force Ware) 0074813

IMPULSE and DYNERGIT cartridges

Description
The IMPULSE range of electrically initiated cartridges is available in NATO standard calibres 12.7 mm and 20 mm.

The 12.7 mm cartridge is used in the TEL220, HELIOS and other EOD equipment, while the 20 mm cartridges are used with HELIOS and other systems; the 20 mm DYNERGIT cartridge is used with the DYNERGIT disruptor, PORTAS and TELEMACH.

Specifications
Weight
12.7 mm (100 rounds, packed): 8 kg
20 mm (100 rounds, packed): 17 kg
20 mm DYNERGIT (100 rounds, packed): 16 kg

Status
Available and in service with several military and police EOD/IEDD teams worldwide.

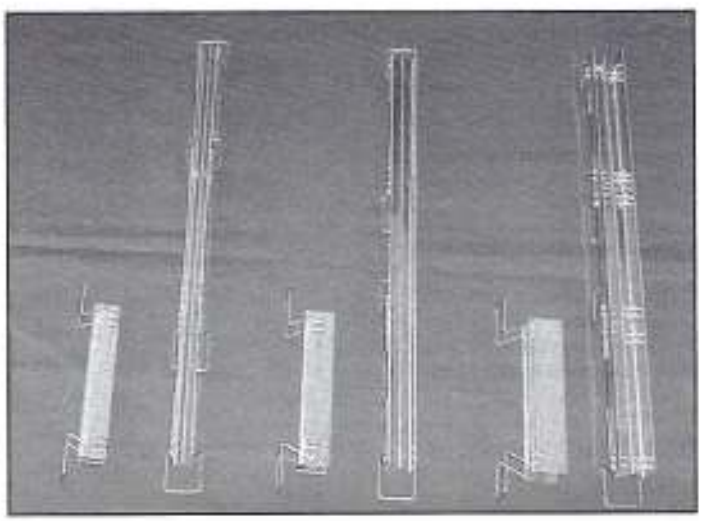
Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.

KATANA linear shaped charge set

Description
KATANA linear shaped charges are available in various sizes to allow penetration power to be matched to the wall thickness of the unexploded ordnance. For situations where the actual wall thickness is not known the KATANA set includes an ultrasonic wall measurement device, DM4. This has a digital display of the thickness of steel and other metals and comes with a dust- and waterproof housing. Its operational endurance is up to 200 hours.

Both KATANA and DM4 are supplied in a sturdy plastic case.

Specifications
KATANA dimensions, when packed
length: 46 cm
height: 19 cm
width: 32 cm



KATANA linear shaped charges are available in various sizes
(telerob)
0121000

KATANA weight, when deployed: 5 kg
KATANA weight, when packed: 11 kg
DM4 dimensions, when deployed
length: 15 cm
height: 8 cm
width: 3 cm
DM4 weight, when deployed: 0.25 kg

Status
Available.

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.

MEL 220 Disrupter

Development
The MEL 220 disupter was developed in collaboration with German EOD and bomb disposal squads. It was designed to disrupt and destroy improvised explosive devices (IED) of different shapes and materials whilst avoiding explosions.

Description
The MEL 220 can either be fired from its own frame, sand bags or by an optional stand. It can be used with water, sand, wood and steel. The MEL 220 is delivered as a complete set together with frames, as well as a small set of different wood, plastic and metal firing bolts. It uses 0.5 cal (12.7 mm) cartridges (MEL 2212).

Specifications
Length: 235 mm
Outer diameter: 50 mm
Inner diameter: 25 mm
Weight of disrupter with support frame: 5.5 kg
Weight of complete set in case: 12.6 kg

Status
In production.

MEL 220 Disrupter (MELTRON International Security Services) 1298748

Contractor
MELTRON International Security Services GmbH.

TDW EOD shaped charges

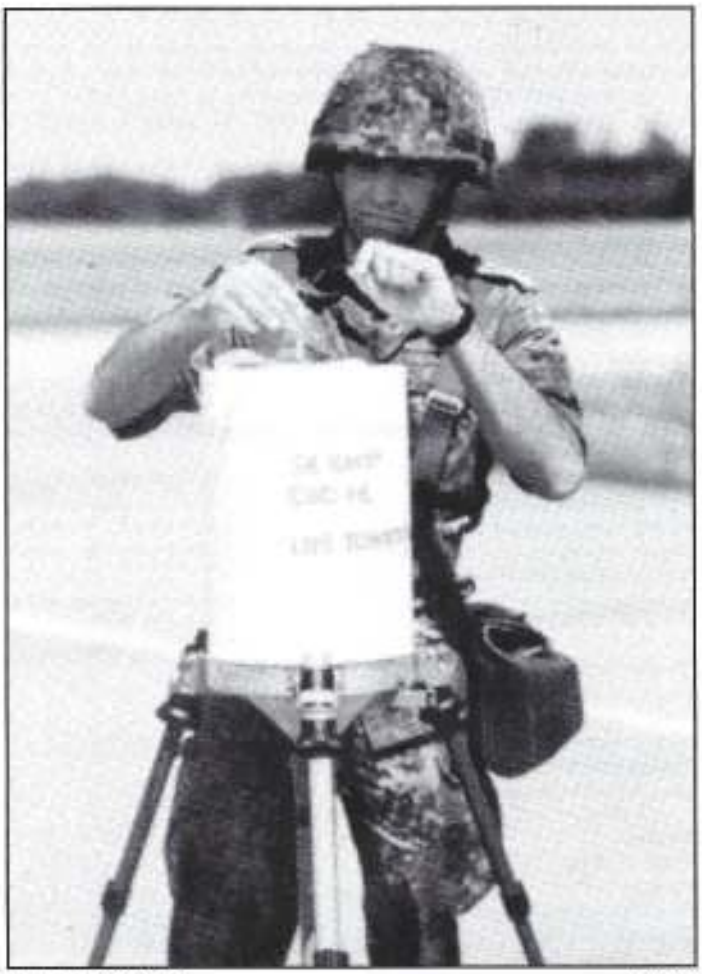
Description
TDW produced a range of shaped charges for use in EOD.

EOD-HL 21 The smallest of the range, the EOD-HL 21, was designed to clear unexploded ordnance (UXO) with wall thickness of up to 30 mm in a low-order mode. This device was non-magnetic and used at a maximum standoff of 350 mm. It was also used underwater at depths of up to 60 m. EOD-HL 21 was activated with a wide range of commercial detonating equipment.

EOD-HL 106 This was a high-order technique EOD charge designed to initiate UXO buried at depths of up to 1.5 m. Aiming was achieved by aligning the charge vertically above the target.

EOD-HL 200 A larger version of the 106, this was also a high-order technique EOD charge for UXO buried to depths of up to 4 m.

EOD-HL 106 (TDW) 0074425



EOD-HL 200 (TDW) 0074426

Specifications
EOD-HL 21
diameter: 32 mm
length: 95 mm
weight: 140 g
explosive type: RDX
explosive weight: 18 g
liner: copper cone
EOD-HL 106
diameter: 130 mm
length: 230 mm
weight: 2.1 kg
explosive type: TH
explosive weight: 1.86 kg
liner: copper cone
penetration depth: 1.5 m + target
EOD-HL 200
diameter: 240 mm
length: 412 mm
weight: 13 kg
explosive type: TH
explosive weight: 12 kg
liner: copper cone
penetration depth: 4 m + target

Status
No longer in production.

EOD-HL 21 (TDW) 0074424

Contractor
TDW (as of March 2006 TDW became part of the European missile company MBDA).

WIRECUTTER pyrotechnic wire cutter

Description
The WIRECUTTER consists of a pyrotechnic element and a small blade. It can be used to cut cables up to 5 mm thick from a safe distance. The blade can be reused several times. The device utilises an electrical initiator.

Status
No longer in production. In service with several military and police EOD/IEDD teams worldwide.

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.

Israel

Carpet Minefield Clearing and IED Neutralization/Detonation System

Description
Carpet is a modern anti-tank minefield clearing and IED neutralization system consisting of a launcher assembly containing 20 rockets equipped with Fuel Air Explosive (FAE) warheads that can neutralize all types of IEDs. The system is operated by a crew of two from inside the crew compartment in order to achieve maximum protection.

The Carpet launcher is an autonomous add-on kit that can be fitted to any main battle tank or suitable military vehicle easily and quickly in the field. The vehicle stops about 65 m from the edge of the anti-tank minefield, and the launcher is elevated; the rockets are then fired over the minefield starting at the far end. The FAE in the rockets is expelled and forms a cloud, which is then ignited and the resulting overpressure detonates the anti-tank mines below. The longer duration pressure blast is more likely to initiate blast-susceptible mines, and may initiate first-generation blast-resistant mines.

A path up to 100 m long can be cleared in less than 1 minute; the cleared path being marked by rocket fins. The vehicle would then enter the minefield and use front-mounted mineclearing rollers to detonate any remaining mines.

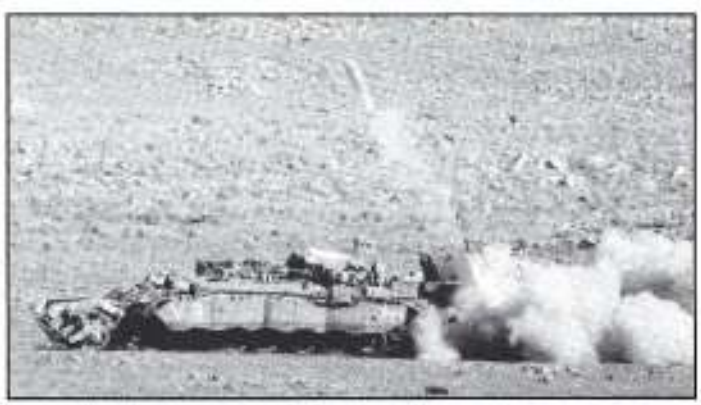
The standard MBT-mounted Carpet launcher is self-contained, with no hydraulic power required from the host vehicle. All that is required is a 24/28 V power supply. The launcher can also be towed behind, or installed inside, an armoured personnel carrier. The Carpet system can be used in any terrain and in all weather conditions.

Training rockets can be provided, and the control panel mounted inside the vehicle also features built-in test circuits.

Specifications
Launcher (MBT-mounted option)
Total weight: 3.5 tons
Dimensions: 3.0 × 2.0 × 1.32 m
Rocket pod dimensions: 0.92 × 1.32 × 2.4 m
Mounting frame dimensions: 3 × 1 m

Rockets
Weight: 46 kg
Length: 1.39 m
Outer diameter: 265 mm
Fin span: 350 mm
Firing range: 65–165 m
Firing modes: automatic, semi-automatic, single shot

Loading the Carpet's rear-mounted launcher (RAFAEL) 0127363



Carpet being launched over a minefield from a Puma armoured engineer vehicle fitted with front-mounted rollers (RAFAEL) 0127362

Status
In production. Operational with the Israel Defence Forces and French Army.

Contractor
RAFAEL (Ordnance and Protection Division).

New configuration of Carpet is air-transportable (RAFAEL)
1299244

New Zealand

Battlefield Inoculation Remote Initiation System (BIRIS)

Development
BIRIS is a secure, UHF digital radio-controlled system designed for the remote initiation of explosives and pyrotechnics for conventional demolitions and battle simulation.

Description
The system consists of one transmitter and up to 10 receiver units, each receiver capable of initiating 10 lines, allowing a complete system to initiate up to 100 lines. Receivers can be configured to be either individually or collectively addressed. The UHF digital signal provides enhanced flexibility over hard wire systems. Features include a manual on/off key with two-handed key press to transmit firing commands, comprehensive error checking process to ensure integrity of firing commands, programmable firing sequence and firing history.

Each receiver is a waterproof aluminium housing containing the electronics necessary to accept and interrogate firing commands. Each line on the receiver can fire through 25 ohms of line resistance.

The transmitter is a hand-held waterproof aluminium housing containing the UHF digital radio and other associated electronics. The batteries can support 300 firings at 25°C.

BIRIS is fully electromagnetic compliance tested in accordance with Def Stan 59-41 and is built to Mil Spec 810E specifications.

Specifications
Operating range: 3 km in urban areas, 3–5 km in open terrain and 10–25 km line of sight
Firing output power: 300 mJoules at 50 V
Frequency range: UHF/FM 385-390 MHz or 405-410 MHz
Dimensions (w × d × h):
(transmitter) 100 × 50 × 300 mm
(receiver) 160 × 95 × 300 mm
Weight:
(transmitter) 2.1 kg
(receiver) 4.4 kg

BIRIS remote initiation system (MAS Zengrange) 0074427

Power source:
(transmitter) AA Alkaline or Lithium
(receiver) C Alkaline
Environmental temperature range: –30 to +55°C
Battery life: 120 h at 25°C
NATO stock number
transmitter: 5820-98-204-0217
receiver: 5820-98-204-0216

Status
In production. In service with NATO countries and worldwide.

Contractor
MAS Zengrange (NZ) Limited.

Floating PRIME (Portable Remote Initiator for Munitions and Explosives)

Development
Floating PRIME is an UHF digital radio-controlled system designed to electrically initiate demolitions on the surface of water; in harbours, inland waterways and coastal areas.

Description
The system comprises of one transmitter and either 5 or 10 receivers and one floating container per receiver. The set includes specialised accessories designed to expand the capabilities of the system.

The UHF digital signal provides enhanced flexibility over hard wire systems. Features include a manual on/off key with two-handed key press to transmit firing commands, comprehensive error checking process to ensure integrity of firing commands, programmable firing sequence and firing history.

The receiver is a waterproof aluminium housing containing the electronics necessary to accept and validate firing commands. When used in waterborne operations, the receiver is housed in a rugged HDPE waterproof container. The receiver fires through 24 ohms of line resistance. The transmitter is a hand-held waterproof aluminium housing containing the UHF digital radio and other associated electronics. The batteries will support 300 firings at 25°C.

The Floating PRIME system is fully electromagnetic compliance tested in accordance with Def Stan 59-41 and is built to Def Stan 00-35 specifications.

Specifications
NATO stock number
transmitter: 5820-98-204-0217
receiver: 5820-98-204-1081

For details of the latest updates to *Jane's Explosive Ordnance Disposal* online and to discover the additional information available exclusively to online subscribers please visit
jeod.janes.com

Operating range:
(calm water) 2–3 km
(rough water) 1 km
Firing output power: 300 mJoules at 50 V
Frequency range: UHF/FM: 385–390 MHz or 405–410 MHz
Dimensions (w × d × h):
(transmitter) 100 × 50 × 300 mm
(receiver) 85 × 120 × 48 mm
(container) 170 × 170 × 310 mm
Weight:
(transmitter) 2.1 kg
(receiver) 600 g
(container) 3.4 kg
Power source:
(transmitter) AA Alkaline or Lithium
(receiver) D Alkaline or Lithium
Environmental temperature range: –30 to +55°C
Battery life: 120 h at 25°C

Status
In production. In service with NATO countries.

Contractor
MAS Zengrange (NZ) Limited.

Floating PRIME
(MAS Zengrange)
0573705

Portable Remote Initiator for Munitions and Explosives (PRIME)

Development
PRIME is a secure, UHF digital radio-controlled system designed for the remote initiation of munitions and explosives. The system can also be employed as a training system to initiate explosives in order to provide battlefield noise simulation during battle inoculation training.

Description
The system consists of one transmitter and either 5 or 10 receiver units including specialised accessories designed to expand the capabilities of the system. Receivers are operator configured to be individually or collectively addressed in order to enhance mission specific tasks. The UHF digital signal provides enhanced flexibility over hard wire systems. Features include a manual on/off key with two-handed key press to transmit firing commands, comprehensive error checking process to ensure integrity of firing commands, programmable firing sequence and firing history.

The receiver is a waterproof aluminium housing containing the electronics necessary to accept and interrogate firing commands. The receiver can fire through 25 ohms of line resistance. The transmitter is a hand-held waterproof aluminium housing containing the UHF digital radio and other associated electronics. The batteries support 300 firings at 25°C.

The operating range within an urban environment is approximately 3 km. In open terrain 3 to 5 km could be expected, whilst under line of sight conditions ranges of 10 to 25 km are possible.

PRIME single-line receiver (MAS Zengrange) 0074428

PRIME transmitter (MAS Zengrange) 0074429

PRIME is fully electromagnetic compliance tested in accordance with Def Stan 59-41 and is built to Def Stan 00-35 specifications.

Specifications
NATO stock number
transmitter: 5820-98-204-0217
transmitter: 5820-98-204-1081
Operating range: 3 km in urban areas, 3–5 km in open terrain and 10–25 km line of sight
Firing output power: 300 mJoules at 50 V
Frequency range: UHF/FM 385–390 MHz or 405–410 MHz
Dimensions (w × d × h):
(transmitter) 100 × 50 × 300 mm
(receiver) 85 × 120 × 48 mm
Weight:
(transmitter) 2.1 kg
(receiver) 600 g
Power source:
(transmitter) AA Alkaline or Lithium
(receiver) D Alkaline or Lithium
Environmental temperature range: –30 to +55°C
Battery life: 120 h at 25°C

Status
In production. In service with NATO and worldwide.

Contractor
MAS Zengrange (NZ) Limited.

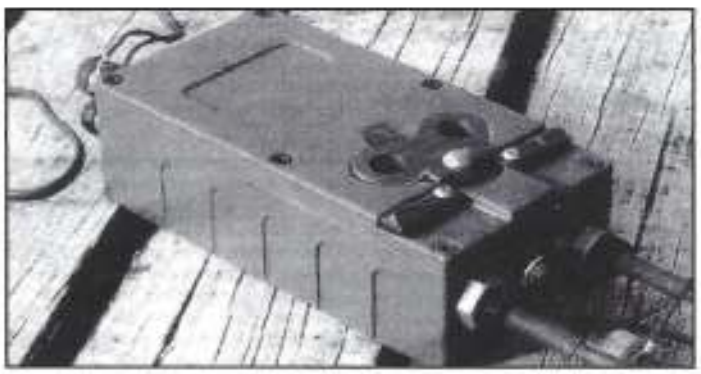
Viking STI shock tube initiator

Development
Viking STI is a dual shock tube initiation system designed to operate in conditions where the use of electric detonators is considered unsafe.

Description
The system can be initiated manually or by remote control using the PRIME UHF digital radio-controlled system (see separate entry). Initiation by remote control allows for controlled, command detonation of shock tube at long range. Viking incorporates a dual initiation system to ensure reliability. Other features include individual safety catches for each firing mechanism, manual de-cocking mechanism, modular firing pin assemblies to fit either US or European shock tube. The body is constructed of a waterproof aluminium alloy containing the components necessary to trigger its dual firing mechanisms.

A manual two-way twist cocking action is required in order to render the Viking STI safe if required. The operating range using a radio-controlled system within an urban environment is approximately 3 km. In open terrain 3 to 5 km could be expected, whilst under line of sight conditions ranges of 10 to 25 km are possible.

Specifications
NATO stock number: 1375-98-205-8961
Operational range: When used with PRIME (see separate entry), 3 km in urban areas, 3–5 km in open terrain and 10–25 km line of sight



Viking shock tube initiator (MAS Zengrange) 1042491

Dimensions (l × w × h): 195 × 76 × 50 mm
Weight: 1.13 kg
Environmental temperature range: –30 to +50°C

Status
In production and in service.

Contractor
MAS Zengrange (NZ) Limited.

Switzerland

SM-EOD systems

Description
RUAG Land Systems, Warhead Division makes a range of shaped charges and accessories suitable for the explosive disposal of most types of unexploded ordnance (UXO). The target can be visible or covered with soil, snow or water to the depths given below. The SM-EOD systems consist of an initiation unit, shaped charge and mounting fixture. In use, the device is directed at the munition at a distance appropriate to the location and type of ordnance. The charge is then initiated either electrically or pyrotechnically, from a safe distance. A variety of mounting fixtures (including an adjustable tripod and a rod) is available for use in different ground conditions. Two aiming devices are available: SM-Aim20/33 for the two smallest charges, and an optical aiming device, SM-Aim67, for use with the SM-EOD67.

The SM-EOD33P Projectile Charge is used for the safe and contact-free disruption of UXO and improvised explosive devices (IEDs) at 0 to 500 mm standoff.

The SM-EOD Bag contains four SM-EOD20 and four SM-EOD33 systems packed into a rugged plastic transit case, along with all necessary accessories.

SM-EOD20 in use (RUAG Land Systems) 1041237

Specifications

SM-EOD Specifications	SM-EOD20	SM-EOD33	SM-EOD33 USA	SM-EOD33P	SM-EOD67	SM-EOD130	SM-EOD190
Outer diameter:	24 mm	37 mm	37 mm	37 mm	70 mm	142/150 mm	220 mm
Length:	55 mm	85 mm	85 mm	90 mm	162 mm	245 mm	297 mm
Total weight:	96 g	185 g	185 g	190 g	887 g	5.35 kg	15.42 kg
Explosive mass:	11.5 g	57 g	57 g	24 g	444 g	2.94 kg	8.44 kg
Liner:	copper	copper	copper	copper	copper	copper	copper
Body:	plastic	plastic	plastic	plastic	aluminium	plastic	plastic
Max depth:	100 mm	170 mm	170 mm	–	1.5 m	2.5 m	4.5 m
Ex. Number:	2002100172	–	2002100170	pending	pending	pending	pending
Classification:	UN No 0441 Class 1.4S	UN No 0441 Class 1.4S	UN No 0059 Class 1.1D	UN No 0441 Class 1.4S	UN No 0059 Class 1.1D	UN No 0059 Class 1.1D	UN No 0059 Class 1.1D

SM-EOD Bag
length: 360 mm
width: 316 mm
height: 111 mm
weight: 5 kg
SM-Aim20/33
range: up to 1 m
weight: 50 g
SM-Aim67
range: up to 10 m
weight: 300 g

Status
In production. In service with the Austrian, Dutch, Finnish, and Swiss Armies and the Danish Navy.

Contractor
RUAG Land Systems, Warhead Division. It emerged in July 2007 that a majority stake in RUAG's Warheads Division within the Land Systems business had been sold to Saab and renamed Saab Bofors Dynamics Switzerland.

SM-EOD Bag (RUAG Land Systems) 0074379

United Kingdom

AB Precision MINEX miniature exploder

Development
The MINEX is a single-channel miniature exploder designed to be operated in one hand, if necessary while wearing NBC gloves and cold weather clothing. It is capable of initiating up to two L2A1 detonators.

Description
The 'arm' and 'fire' switches are fitted on one side of the case for operation with the index and middle finger. The 'test' button is fitted on the top. Also on the top is the LED firing counter with the test and arm indicators. The terminal block is situated at the bottom and connection is effected without the need to strip insulation. MINEX can deliver 50 test, arm and fire operations on one set of four AA size batteries, negating the requirement for chargers.

A Shock Tube Adaptor is connected to the MINEX by sliding it onto the bottom rail until the connectors press into the terminal assembly. With the adaptor fitted MINEX is able to deliver 50 firing pulses on one set of batteries. The test button and LED are not operative when using the Shock Tube Adaptor.

Continuity testing is achieved within 1 second of depressing the 'test' button, provided the detonator circuit impedance is less than 57 Ω. Arming is achieved within 2.5 seconds of depressing the 'arm' button. Firing is achieved within 10 ms of pressing the 'fire' button. If the 'arm' button is released before the 'fire' button is depressed, the unit returns to the unarmed state within 2 seconds.

Specifications
Firing unit, including batteries:
length: 125 mm
width: 40 mm
height: 71.5 mm
weight: 0.29 kg
Shock Tube Adaptor:
length: 70 mm
width: 38 mm
height: 56 mm
weight: 0.19 kg

Status
In production and in service.

Contractor
AB Precision (Poole) Limited.

Ergonomic controls of the MINEX exploder (AB Precision) 0074253

MINEX exploder, Shock Tube Adaptor and case (AB Precision) 0074252

BLADE® linear shaped cutting charge

Description

BLADE is a linear shaped cutting charge designed to combine high performance with ease of operation in a wide variety of tactical situations and environments. Highly flexible, BLADE can be rapidly attached to a target structure using the bonding system fitted to the base. This system has been specially developed and tested under extreme conditions giving BLADE the capability of rapid and reliable deployment when fixed to a variety of structures.

It is available in a number of charge sizes, which have been designed to overlap in performance to limit the number of charges that need to be carried by an engineer or assault team. BLADE can be cut using simple hand tools and initiated using standard military detonators, detonator cord boosters, flash detonators and non-primary explosives.

BLADE is IM compliant and has been qualified by the UK Ministry of Defence for general service use. It has been sold throughout the world both to military and civilian users.

All BAE SYSTEMS RO Defence plastic explosives comply with the requirements of the Montreal Convention on the Marking of Explosives 1991.

Specifications

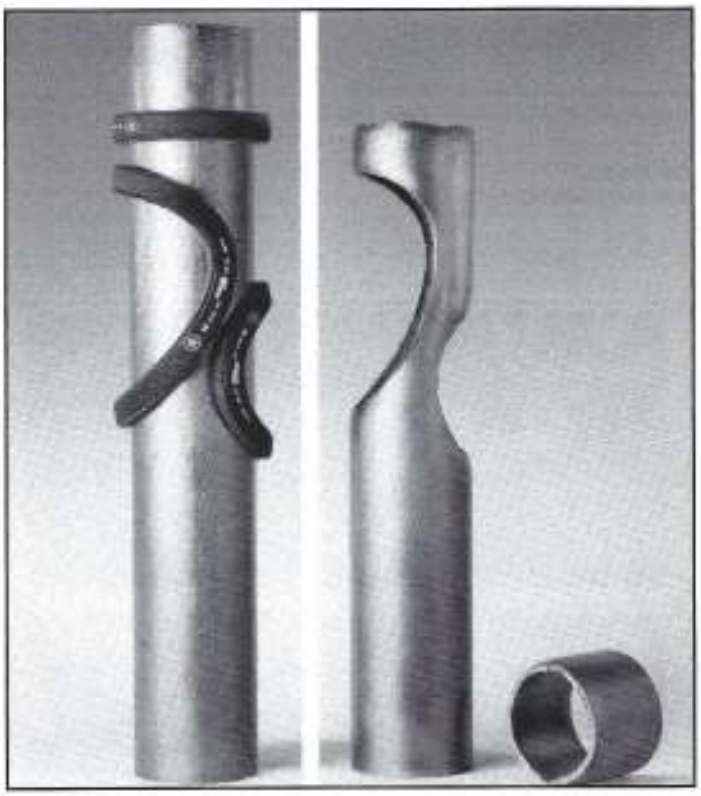
Explosive content	Typical cutting thickness Steel (BS4360/ 1986 Grade 43A)	Aluminium (BS6082-T6)	Wood (Oak)	Laminated Glass
63 g/m	3 mm	10 mm	30 mm	10 mm
100 g/m	6 mm	20 mm	40 mm	10 mm
240 g/m	10 mm	35 mm	70 mm	26 mm
450 g/m	15 mm	45 mm	100 mm	50 mm
650 g/m	20 mm	65 mm	140 mm	–
1,150 g/m	25 mm	150 mm	200 mm	–

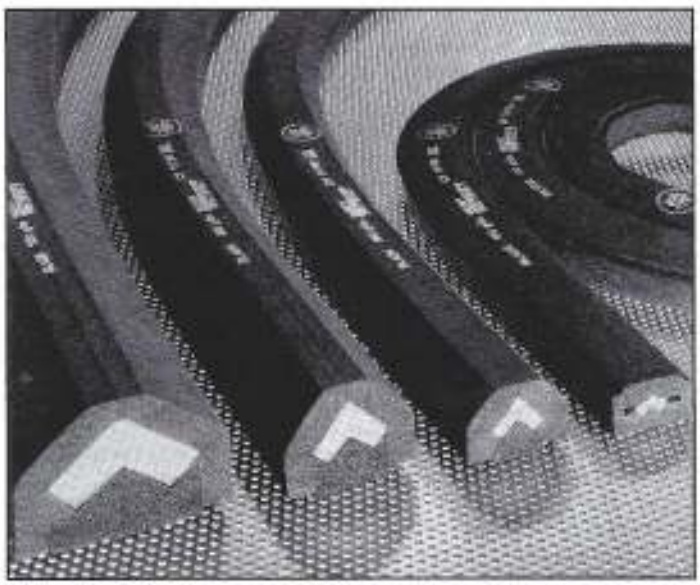
Status

Available.

Contractor

BAE SYSTEMS RO Defence.





Blade linear shaped cutting charges (BAE SYSTEMS RO Defence) 0098005

Blade 100 against BS1387 mild steel tube (165 mm external diameter, 5.4 mm thick wall)
(BAE SYSTEMS RO Defence)
0098006

Demex 100 demolition/EOD explosive

Description

Demex 100 is an RDX-based high-power plastic explosive. It is hand mouldable and has been designed for improvised demolition and EOD work. Demex 100 retains its plasticity over a wide temperature range and can be used under all weather conditions including underwater.

The explosive is available in standard 230 g (8 oz) cartridges, 25 kg bulk, and demolition packs, or to specific customer requirements.

The demolition slab charge pack is available in a plastic box containing 6 × 0.9 kg of explosive slabs designed as an inexpensive alternative to the British Army L3A1 pack. The pack is provided with unique plastic fixing ties for rapid attachment to the target.

Demex 100 is similar in performance to the UK military explosive PE4, which is also available from the same manufacturer.

All BAE SYSTEMS RO Defence explosive products comply with the Montreal Convention on the Marking of Explosives 1991 and the Marking of Plastic Explosives Regulations 1996.

Specifications

High explosive content: RDX 88%
Density: 1.6 g per ml
Velocity of detonation: 8,200 m/s
Plasticity temperature range: –30 to +60°C
Colour: white or green

Status

Available.

Demex 100 plastic explosive and demolition pack
(BAE SYSTEMS RO Defence) 0098007

Contractor

BAE SYSTEMS RO Defence.

Demex 200 demolition/EOD explosive

Description
Demex 200 is an RDX-based high-power plastic explosive in sheet and strip form. It can be easily, accurately and safely cut into charges of precise size and shape and then arranged to maximise or minimise the demolition effect required.

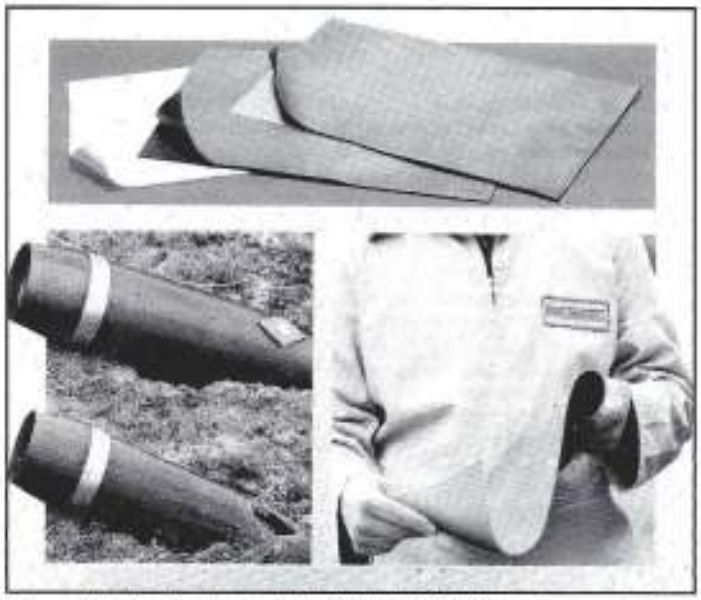
Sheets are available in a variety of thicknesses up to 13 mm and widths up to a maximum 250 mm. Strips are available in thicknesses of up to 13 mm, widths of up to 70 mm and lengths up to 4 m. Demex 200 can also be supplied in pre-cut shapes to individual customer requirements. The explosive is waterproof and is produced in an olive drab colour with or without a self-adhesive backing. Plastic magnetic strips can be fixed using this self-adhesive backing to facilitate fitting to steel or iron targets.

Demex is designed to be similar to UK military SX2 sheet explosive, which is also available from the same manufacturer.

All BAE SYSTEMS RO Defence explosive products comply with the Montreal Convention on the Markings of Explosives 1991 and the Marking of Plastic Explosives Regulations 1996.

Specifications
High explosive content: RDX 88%
Density: 1.63 g per ml
Velocity of detonation: 7,800 m/s
Plasticity temperature range: –30 to +60°C
Colour: olive green

Status
Still available. No longer marketed.



Demex 200 sheet explosive (BAE SYSTEMS RO Defence) 0098008

Contractor
BAE SYSTEMS RO Defence.

Demex 400 demolition/EOD explosive

Description
Demex 400 is a powerful RDX-based extrudable plastic explosive. It can be initiated using a detonator or detonating cord. It has been designed for fast application of controlled amounts of high explosive and is particularly useful for filling into awkward target areas.

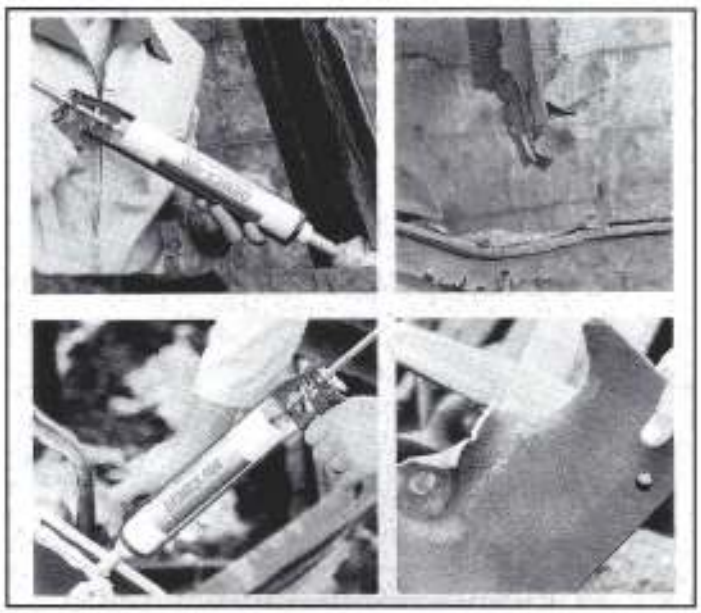
Demex 400 is supplied in mastic cartridges (500, 250 or 125 g) and can be extruded using a standard mastic applicator.

All BAE SYSTEMS RO Defence explosive products comply with the Montreal Convention on the Marking of Explosives 1991 and the Marking of Plastic Explosives Regulations 1996.

Specifications
High explosive content: RDX 88%
Density: 1.6 g per ml
Velocity of detonation: 8,000 m/s
Plasticity temperature range: –20 to +40°C
Colour: light green

Status
Available.

Contractor
BAE SYSTEMS RO Defence.



Demex 400 extrudable plastic explosive (BAE SYSTEMS RO Defence) 0098009

Mini-Shrike explosive initiator

Development
Based on BDL Systems' Shrike initiator (see separate entry), the Mini-Shrike was developed to provide operators with an initiator that can be used with only one hand and employs commercially available batteries, while retaining the proven technology of its predecessor.

Description
The high-energy version delivers a minimum output energy of 4.5 Joules into a maximum resistance of 400 Ω.

Various accessories are available including a dual shock tube adaptor and the Shrike Test Meter (STM) (see separate entry on Shrike).

Specifications
Dimensions: 151 × 58 × 48 mm
Weight: 240 g
Operating temperature: –40 to +70°C (dependent on batteries)
Power supply: 2 × PP3 alkaline batteries
Output voltage: 319–400 V
Output energy: typically 10 J (minimum 4.5 J)
Output load: up to 400 Ω
Arming time: typically 2 seconds
Immersion: to depth of 1.5 m

Status
In production and in service.

Mini-Shrike explosive initiator (BDL Systems Limited) 1299230

Contractor
BDL Systems Limited.

RE Electronic Exploder series

Description
All of the Electronic Exploder series are capable of firing single or multiple arrangements of all standard military detonators, commercial detonators, igniters, fuse heads and electric power cartridges.

RE 130 EEM
A single channel Electronic Exploder featuring circuit test and prime-ready indicators. The exploder is powered by 1 × 9 V PP3 battery (either standard, alkaline or lithium), which is widely available. Made of a rugged reinforced nylon body, the Exploder is both waterproof (to IP66 standard BS 5490) and RFI shielded.

RE 130 EEM Super
This is a more powerful version of the RE 130 EEM.

RE 45 M2
The RE 45 M2 has four channels, each capable of initiating single or multiple detonators to a range of 6 km. Like the other Exploders in the series the RE 42 M2 has an integrated circuit testing facility. The need to simultaneously compress two buttons to fire provides an additional safety feature to prevent accidental firing.

Specifications

	RE 130 EEM	RE 130 EEM Super	RE 45 M2
Output energy:	up to 2.5 Joules at each firing	up to 33 Joules at each firing	up to 33 Joules at each firing
Max firing load/distance:	Up to 150 Ω	Up to 400 Ω	Up to 400 Ω
Typical number of firings:	600 at 20°C	100 at 20°C	100 at 20°C
Max output current:	8.5 Amps	10 Amps	10 Amps
Operating temperature:	–20°C to +60°C	–20°C to +60°C	–20°C to +60°C
Storage temperature:	–40°C to +60°C	–40°C to +60°C	–40°C to +60°C
Dimensions:	125 × 85 × 47 mm	155 × 65 × 45 mm	137 × 102 × 57 mm
Weight:	300 g with battery	250 g with battery	725 g with battery
NATO stock number:	1375-99-457-3003	1375-99-3911-920	1375-99-373-0372

Status
In production and in widespread service.

Contractor
Richmond EEI Limited.

Remote RF Initiator Firing System

Description
Allen-Vanguard's Remote RF Initiator Firing System consists of a Command Unit and up to five Remote Initiator units. Lightweight, it is designed to provide a safe and reliable remote initiation capability for explosive chargers and disruptors.

The Command Unit uses a remote wireless radio link to initiate up to five charges. Secure RF communications guards against trigger of the devices by anything other than the Command unit and intrinsic protection features help prevent accidental initiation. Daylight LED status indicators for all the remote initiators is provided and the unit has over eight hours of mission life in ready mode. It is powered by four 9 V alkaline batteries and weighs less than 1 kg.

Each remote initiator, fully compatible with initiation using detonators/blasting caps and non-electrical shock tubes, is supplied with an Electric Firing Adaptor and a ShockTube Firing Adaptor as standard.

The system can operate at a range of greater than 1,500 m at line-of-sight, depending on environmental conditions. It has a rugged, watertight aluminium construction and has a built-in safe arming time of a minimum 60 s delay.

Status
Available.

Allen-Vanguard's RFI (Allen-Vanguard) 1195366

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

Shrike hard wire explosive initiator

Development
Shrike is a fully approved hard wire initiator designed for the initiation of mines, pyrotechnics and other electro-explosive devices.

Description
Two versions are available: Shrike MKV is for use with standard NATO detonators and Shrike MKIV for the latest VA safety detonators which require a higher energy firing pulse.

Various accessories are available, some of which are also applicable to the Mini-Shrike (see separate entry):

- **Shock tube adaptor:** this is a lightweight accessory which provides the option of using a shock tube (or Nonel) initiation technique, as opposed to wire-connected detonator lines. The adaptor allows the user to initiate shock tube while maintaining the original safety and operational techniques of Shrike;
- **Shrike Test Meter (STM):** STM offers a means of testing the unit and measuring line impedance, and identifying and locating any short circuit that may occur;
- **Batteries:** three specialist batteries (rechargeable nickel cadmium, heavy duty rechargeable nickel cadmium and lithium) have been designed for specific customer requirements;
- **Battery chargers;**
- **Initiator kit:** a lightweight and compact system for the storage and transport of initiators;
- **Backpack:** the backpack includes a firing cable drum and accessories pouch mounted on a lightweight frame; and
- **Dual shock tube adaptor:** dual electric Nonel shock tube initiation is possible using this accessory.

Shrike Exploder (BDL Systems Limited) 1299231

SECTION 4

Specifications

	MKV	MKIV
Size:	140 × 95 × 45 mm	140 × 95 × 45 mm
Weight:	420 g	420 g
Operating temperature:	–40 to +70°C	–40 to +70°C
Power supply:	Ni/Cd or disposable lithium batteries	Ni/Cd or disposable lithium batteries
Output voltage:	319–400 V	719–800 V
Output energy:	typically 12 J (minimum 6.8 J)	typically 48 J (minimum 35 J)
Output load:	up to 400 Ω each circuit	up to 350 Ω each circuit
Arming time:	typically 2 seconds	typically 6–8 seconds

Status
In production and in service in more than 44 countries worldwide.

Contractor
BDL Systems Limited.

United States

ACE™ Advanced Cutting Explosive

Development
ACE™ is intended for a wide variety of military demolition applications, particularly where precise cutting is required or in breaching operations.

Description
The ACE™ Advanced Cutting Explosive is a cutting tool of extreme flexibility, enabling it to follow the contour of complex targets. It uses an RDX-based Plastic Bonded Explosive (PBX) core, manufactured in accordance with MIL-E-46676 and WS 33224, and a novel shaped charge liner. The charge is suitable for underwater use, is self-adhesive to most surfaces, has a built-in standoff and is resistant to fill-in by water.

ACE™ (Ensign-Bickford Aerospace & Defense Company) 0529574

The charge can be cut to allow for field adjustments to the charge length and net explosive weight. Relatively low sensitivity of the explosive to shock reduces the likelihood of accidental or inadvertent detonation.

The manufacturer claims that with its variety of core-loads and ability to cut from 3 mm to more than 25 mm of steel, it can remove or neutralise most obstacles during Combat Engineer operations more effectively and with less explosive product than C-4. Its ease of application is intended to reduce time on target, thereby minimising personnel exposure time.

The manufacturer claims that ACE™ has been successfully tested against a wide range of products, from metal plates and support structures to concrete and brick walls. Additionally, this line of products has demonstrated versatility in urban warfare (MOUT) situations, breaching windows, doors, chain link fences and other similar obstacles.

Specifications
Core: PBX (MIL-E-46676)
Charge performance: NAVSEA OES-0006

Sizes (core load):		
	300 grains/ft	63 g/m
	450 grains/ft	96 g/m
	600 grains/ft	126 g/m
	900 grains/ft	191 g/m
	1,200 grains/ft	250 g/m
	1,800 grains/ft	383 g/m
	2,400 grains/ft	500 g/m
	3,600 grains/ft	765 g/m
	5,400 grains/ft	1,157 g/m

Length: 6.1 m
Packaging: one 20 ft charge per fibre-board box

Status
In production.

Contractor
Ensign-Bickford Aerospace & Defense Company.

Lead-In-Lines

Description
Lead-In-Lines are shock tube detonators used as signal transmission devices to initiate explosive events. They are spooled with an initiating device, a continuous length of shock tube connected to a detonator of known strength and a bunch block accessory. Lead-In-Lines may be supplied in either single or dual tube configurations.

Lead-In-Lines are deployed from the safe area to the intended blast area from the spool. EBA&D can custom manufacture Lead-In-Lines on a non-standard basis for length, output, input and packaging.

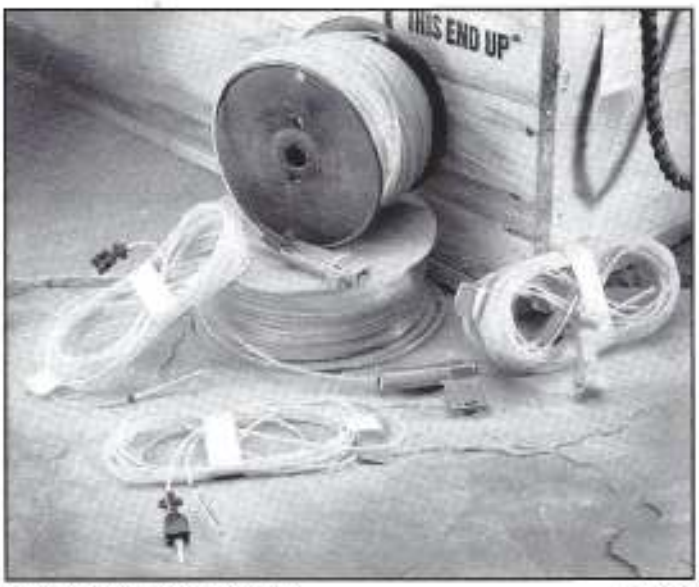
Dual lines are used when conditions or mission requirements deem it necessary to have the maximum reliability. Dual lines have two initiating devices to twinned shock tube leads configured on a spool with detonators and accessories as required. These devices allow for dual path redundancy from the point of initiation to the target. Common applications of dual Lead-In-Lines are underwater demolition, urban breaching, obstacle clearing and critical target destruction.

A Minitube™ version saves up to 50 per cent volume and 40 per cent weight over standard shock tube Lead-In-Lines.

Lead-In-Lines are shipped as explosive class 1.4S for ease of transportation and compatibility with other explosive materials.

Status
In production.

Contractor
Ensign-Bickford Aerospace & Defense Company.



Lead-In-Lines (Ensign-Bickford) 0546826

Linear Shaped Charge (LSC)

Description
Linear Shaped Charge (LSC) is a continuous explosive core enclosed in a seamless metal sheath. Shaped in the form of an inverted 'V', the continuous liner and explosive produces a linear cutting action. This application of the 'Munroe Effect' is enhanced by careful control of charge dimensions and configuration as well as liner and backer thickness and uniformity. It is manufactured in a wide range of core loads for a wide range of cutting applications. It is intended to be used to cut materials such as steel, aluminium and composite section in applications where fast and reliable cutting is required including breaching and EOD operations.

Linear Shaped Charges can be manufactured in core loads ranging from less than 5 grains/ft to more than 1,000 grains/ft. Typical sheath materials include lead, tin alloy and aluminium; commonly used explosives include RDX, PBXN-5, HNS and HMX.

Status
In production.

Contractor
Ensign-Bickford Aerospace & Defense Company.

Linear Shaped Charges can be made in a range of sizes (Ensign-Bickford) 0546825

Liquid Explosive Pouch (LEP) demolition system

Development
During the development of NMX-foam (formerly known as LEXFOAM), a need emerged for a demolition system capable of attacking thick-walled mines and unexploded ordnance. The solution had to retain the convenience, versatility and efficiency of NMX-foam while capitalising on the substantial explosive power of liquid nitromethane. The Liquid Explosive Pouch (LEP) system, which uses a variety of flexible plastic pouches, was taken to Cambodia for operational testing and evaluation, where it proved highly effective. The LEP System has successfully destroyed a variety of AP mines, AT mines, and projectiles up to 155 mm. NMX-foam is covered in a separate entry in this section.

Description
The flexible plastic charges of the LEP system are strong laminated plastic bags fitted with screw tops for ease of filling; these can be made in a variety of sizes and configurations.

The LEP does not become a viable explosive until two components are mixed in the pouches. This minimises the safety and security restrictions for the liquid constituent, which can also be shipped or air-freighted as a flammable rather than explosive.

The flexible plastic casing allows the charge to contour to the shape of the target, and multiple targets can be linked using detonating cord. The system is far less prone to abuse by hostile groups or warring factions than conventional high explosive. LEPs can be initiated by any military or commercial electric detonator. The training needed to use the system is minimal and the cost is less than conventional demolition stores.

LEP charges being placed on a mortar bomb during demolition trials in Cambodia (Colin King) 0074101

Status
In production.

Contractor
Golden West Humanitarian Foundation.

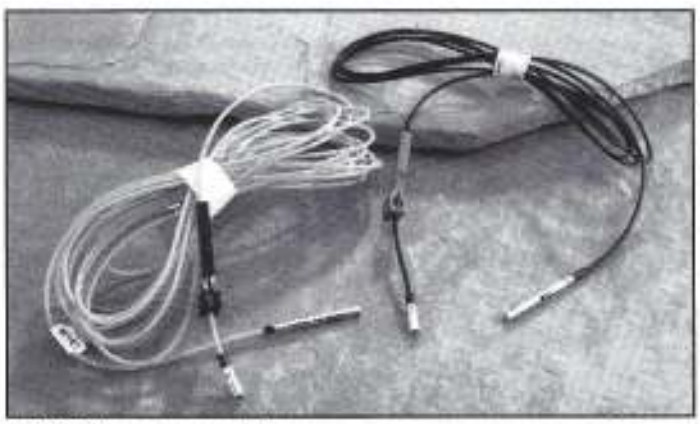
M151/M152 booster assemblies

Description
M151/M152 booster assemblies are military demolition tools designed to improve the military engineer's mission success. The system comprises of PETN PRIMALINE® detonating cord coiled into a 'figure 8', fitted with a 'No 12 strength' booster charge containing PETN and housed in an aluminum shell. J-hooks enable fast, secure, and reliable connection to detonating cords and the crimped end-caps ensure waterproof integrity. Assemblies can be bunched or 'daisy chained' for versatility. Initiation is delivered from detonating cord or blasting caps and function at a rate of 6400 m/s.

M151/M152 booster assemblies are manufactured to stringent military specifications and classified as 1.4D for transport.

Status
In production.

Contractor
Ensign-Bickford Aerospace & Defense Company.



M151/152 booster assemblies (Ensign-Bickford Aerospace & Defense Company) 0529573

NMX-foam liquid explosive foam

Development

NMX-foam (formerly known as LEXFOAM) is a versatile high explosive based on nitromethane, found to have unique applications in mine clearance and other forms of explosive ordnance disposal. Unlike other foam explosives which have very low detonation velocities, NMX-foam typically detonates at about 4,000 m/s. Trials conducted at Fort Belvoir by the US Army endorsed NMX-foam for use in Bosnia after successful demolition of a wide variety of target mines.

Feedback from user trials led to the design of a hand-held unit to augment the existing backpack and palletised delivery systems. In 1998, the Night Vision and Electronic Sensors Directorate (NVESD) at Fort Belvoir awarded a contract for the production of an initial batch of hand-held units. These were successfully tested against a range of live anti-personnel and anti-tank mines at Fort AP Hill before being shipped to Kosovo and Cambodia for operational trials with demining units. As a result of additional comments, further refinements have been made and an improved version of the system is now being produced.

The LEP demolition system (see separate entry) is also based on Nitromethane and was designed to complement NMX-foam for attacking thick-walled mines and unexploded ordnance.

Description

Where mines are to be destroyed in place, NMX-foam offers a rapid and reliable demolition technique for single or multiple targets. Unlike solid blocks of explosive, foam follows the contours of the munition to guarantee intimate contact. Its low density (similar to shaving foam) allows it to be placed on any part of the mine body or fuze without risk of actuation. This means that NMX-foam can be dispensed directly onto the top surface, minimising the time and risk involved in uncovering the mine, taking maximum advantage of the tamping effect offered by the ground and containing fragmentation. NMX-foam is unique in its ability to attack mines placed above the ground; it will adhere to vertical surfaces, such as the trunk of a tree, and remain in position until detonated. Multiple targets may be linked using trails of foam or by detonating cord.

For bulk demolitions, NMX-foam provides quick coverage of stockpiled munitions without the need for expert positioning. The comprehensive coverage and intimate contact of the foam virtually eliminate the chance of partial detonation or 'kick-outs'. This generally allows more ordnance to be destroyed during each demolition, while complete detonation eliminates unwanted explosive residue.

The hand-held unit is the primary dispenser for use during demining operations. This is a disposable two-component system, which can be shipped or air-freighted without the expense and restrictions associated with conventional high explosives. An aerosol can contains NMX-foam stock solution, while a separate canister contains the propellant; in this form, each component remains non-explosive. When required for use, the propellant canister is simply inverted onto the can to mix the components. The aerosol is then ready to dispense the explosive foam.

Dispensing NMX-foam onto live PMN-2 mines during trials in Cambodia (Colin King) 0074100

For bulk use, NMX-foam can be dispensed from either a 10 kg capacity backpack or a 200 kg capacity palletised unit, which may be truck mounted. Stock solution for these dispensers is transported in 55 US gallon (208.2 litre) drums, where it is classified as a flammable liquid, not as an explosive. In this form it is virtually useless to hostile groups or warring factions, minimising the security concerns associated with conventional high explosives. Before use, the solution is mixed with liquid propane in a dispersal tank and is over-pressurised using nitrogen. It is sprayed through a wand, which may be up to 3 m long and incorporates a detonation trap.

Once dispensed, any military or commercial detonator can be used to initiate the foam. It is non-toxic and biodegradable; if the explosive foam is not used, it will safely self-neutralise within a few hours. The training needed to use the system is minimal, and the cost is competitive with conventional demolition stores.

Status

Continued development and limited production.

Contractor

Golden West Products International.

Non-electric detonators

Development

Ensign-Bickford's non-electric detonators are designed to be used in military demolitions, explosive ordnance disposal, minefield clearing, explosives testing and other special applications. The company manufactures devices of varied lengths with specific outputs and associated accessories. The detonators are designed to be interoperable with munitions, cap wells, detonating cords, high explosives and Lead-In-Lines.

Description

Ensign-Bickford's non-electric detonators are linear signal transmission devices designed to transmit an energetic signal through shock tube to a specific detonating output. Shock tube is a hollow extruded tube containing a thin layer of energetic material on its inner diameter. Once initiated, the shock tube transmits a signal to a detonating output charge, typically incorporating a predetermined pyrotechnic delay. Non-Electric Detonators are available in either single or dual shock tube configurations.

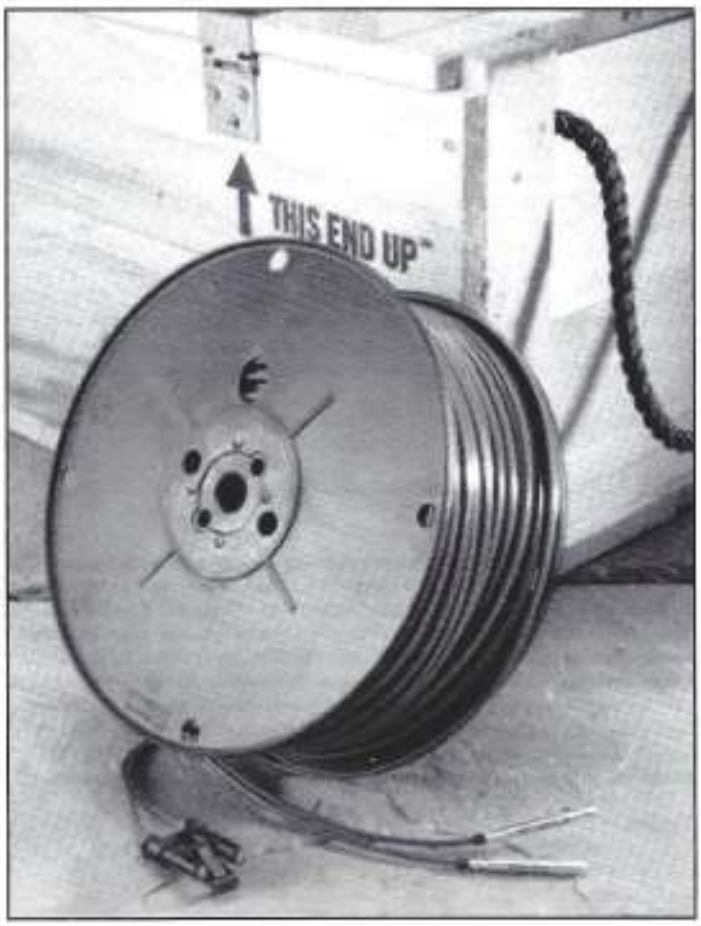
Numerous designs are available in single and dual lead, instantaneous or delay timing and No 8 or No 12 strength outputs. All detonators are shipped as Hazard Class 1.4S to maximise ease of transport and storage.

Status

In production.

Contractor

Ensign-Bickford Aerospace & Defense Company.



Dual lead non-electric detonator (Ensign-Bickford Aerospace & Defense Company) 0529575

Primasheet® 1000 flexible explosive

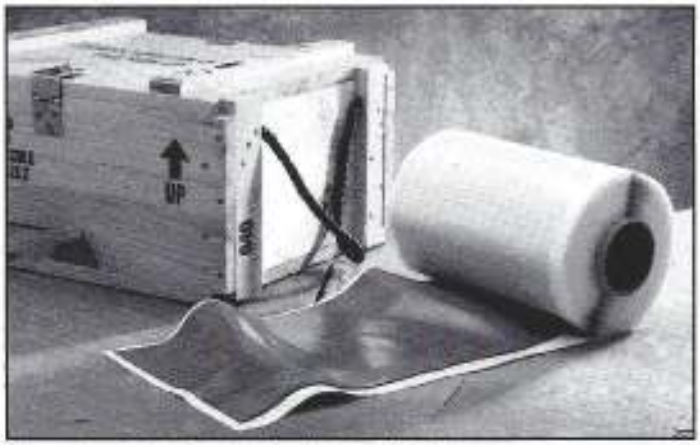
Description

Primasheet® 1000 flexible explosive is a water and moisture-proof PETN-based (63% nominal) flexible sheet explosive. Manufactured in accordance with MIL-E-46676 in a continuous roll of varying lengths and thickness, it is suitable for small scale demolition work where blast damage can be mimimised by exact cutting of the sheet.

Primasheet® 1000 can be cut into strips, diamonds or numerous other shapes. The shapes are applied with adhesive directly onto the target or used to improvise linear shaped charges. Strips or sheets can be layered one on top of the other in the field to create thicker charges. Primasheet® 1000 maintains a consistent density and explosive output, even after significant charge manipulation. Sheets of thickness 1 to 8 mm are available: thicker charges can be manufactured if required.

Specifications

Density: 1.42 ± 0.02 g/cm³
Typical VOD: 7,000 m/s
Composition: 63.5 ± 3.0% PETN
Width: 254 mm (can be configured from 127 to 560 mm)
Thickness: 2 to 8 mm
Length: dependent upon thickness



Primasheet® flexible explosive (Ensign-Bickford) 0567415

Status

In production. In use with US Military Forces.

Contractor

Ensign-Bickford Aerospace & Defense Company.

Primasheet® 2000 flexible explosive

Description

Primasheet® 2000 flexible explosive is a water- and moisture-proof RDX-based (88% nominal) flexible sheet explosive. Manufactured in accordance with MIL-E-46676 and WS 3322, it is suitable for small scale demolition work where blast damage can be minimised by exact cutting of the sheet.

Primasheet® 2000 can be cut to any shape and applied with adhesive. It can be applied as strips or diamond shapes directly on the target or used to improvise linear shaped charges. Strips or sheets can be layered one on top of the other in the field to create thicker charges. Primasheet® 2000 maintains a consistent density and explosive output, even after significant charge manipulation. Sheets of thickness 2 to 8 mm are available: thicker charges can be manufactured if required.

Specifications

Density: 1.62 ± 0.02 g/cm³
Typical VOD: 7,800 m/s
Composition: 88.1 ± 2.0% RDX
Width: 254 mm (can be configured from 127 to 560 mm)
Thickness: 2–8 mm
Length: dependent upon thickness

Primasheet® flexible explosive (Ensign-Bickford) 0529570

Status

In production. In service with US Military Forces.

Contractor

Ensign-Bickford Aerospace & Defense Company.

IMAGING AND MONITORING

Belgium

Sector 6 Image Storage Panel (ISP)

Description
The Image Storage Panel (ISP) is an electroluminescent device with very specific and unusual characteristics. When exposed to X-rays of between 40 and 400 kV, and then connected to an AC power supply, the ISP glows a bright green. Unexposed areas remain dark and partial exposures produce intermediate results. The overall brightness and contrast can be adjusted by varying the applied voltage between 100 and 250 V.

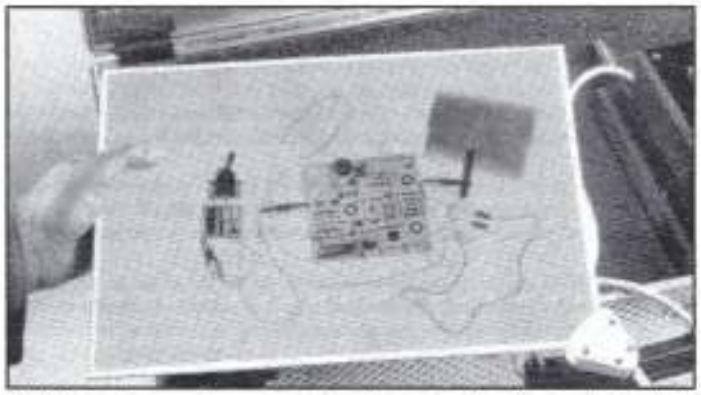
In practice, when used in place of conventional X-ray film, the ISP produces a positive X-ray image of the object being examined, with metal objects showing as black on a glowing green background.

The X-ray image is 'stored' on the ISP for a period, depending on its temperature. At 0°C the image will remain for 24 hours or more and at 100°C it disappears completely in about 5 minutes. At 20–25°C a fully exposed ISP will store the image for about 30 minutes and then slowly degrade over a period of several hours. When the image has disappeared entirely, the ISP has reverted to its non-excited state and is ready for re-use. The cycle can be repeated almost indefinitely.

The overall life of the ISP depends entirely on its switched-on time. Its useful life is in excess of 200 hours, so that one ISP could, for example, be used to take 2,000 pictures and view each one for 6 minutes, or 4,000 pictures for 3 minutes and so on.

A further unusual feature of the ISP is that it is insensitive to over-exposure. In fact, very long exposures actually help to increase the image storage time. Any excess brightness can be eliminated by reducing the applied voltage, and contrast can be varied by the same method. Under-exposure, on the other hand, leads to a 'washed-out' exposure with a very short life.

Specifications
Panel size: 25 × 36 cm
Thickness: 2 mm



An ISP showing an image of a typical improvised explosive device (IED). The panel background is green and the details in black and grey shades
0515759

Weight: 440 g
Operating voltage: 50–240 V
Max voltage: 350 V
Resolution: 5 line pairs/mm
Max contrast ratio: 400:1
Dose to give contrast ratio of 100: 1.0 rad
NATO Stock Number: 6525-13-112-8510

Status
Believed to still be available.

Contractor
Sector 6 Technologies.

Sector 6 ISP kits

Description
Mark 1
Sector 6's ISP kit is a portable range of Image Storage Panels (ISPs, described in a separate entry) for use with X-ray generators in the examination of suspicious objects. The complete kit, to NATO standards, consists of four ISPs, complete with protective perspex covers; one collapsible viewing hood; two perspex stands for holding the ISP; one mains cable connection for 220 V; one cable for connecting to the ISP; one heater block unit; and one hand-held inverter (12 V DC/220 V AC) powered by eight AA batteries, for independent viewing of the ISP.

In use, the kit is connected by its cable to a power source and, if required, the heater block is placed alongside the case. After exposure, the ISP is attached to the viewing cable and placed in the viewing compartment. The kit is switched on, and the X-ray image appears on the ISP. Brightness and contrast can be adjusted by means of a rheostat. The viewing hood can be used in bright conditions or when taking a photograph of the X-ray image for permanent record.

For rapid image erasure the ISP is placed in the heater block which, when activated, heats to 100°C. The image disappears in about 6 minutes at that temperature. When the ISP has cooled to room temperature it is again ready for use.

The kit is contained in a heavy-duty aluminium case, measuring 68 × 40 × 18 cm, and weighs 16 kg.

Mark 2
The Mark 2 was developed in the light of field experience gained with the Mark 1 kit. In effect, because of the high percentage of first-time successes, it is frequently unnecessary to heat-erase the ISP for rapid re-use. With four ISPs in the kit, quite large objects can be examined without having to re-use an ISP. For this reason, the heat erasing and viewing functions have been separated into two lightweight but robust cases.

ISP kit Mark 1
0515760

For many operations, only the viewing case need be taken to the scene, with a substantial saving in weight and volume. In addition, the viewing case is battery operated, with a six-position contrast control switch, thus eliminating the need for a power source to view the X-ray image. The heat erasure case can be left at base or in an EOD vehicle.

Status
Believed to still be available.

Contractor
Sector 6 Technologies.

Sector 6 portable fluoroscopic systems

Description
Sector 6 produces a range of extremely lightweight and compact fluoroscopic units for use with any of the three Sector 6 X-ray generators. When used with the Six-ray HPR generator, the entire system is battery powered, giving it a 'go-anywhere' quality which is useful for military, police and customs users.

The console also contains four microprocessor-controlled digital memories of 512 kbytes per video page. This allows the operator to take four X-ray pictures with exposures as short as 0.2 seconds, and then to view and store them for any length of time, or to obtain hard-copy prints via an optional video printer. Many hundreds of X-ray images can be obtained without need to recharge the built-in battery.

The RTVS Mk 3 can be used with the Golden INSPECTOR X-ray generator, in addition to the three models mentioned above.

The viewing modules are available in two standard sizes:

RTVS/2432. With a screen size of 24 × 32 cm, an overall length of only 31 cm and a weight of less than 3 kg complete, it is the most compact unit currently available. Used with the Six-ray HPR generator, the total weight of the two items is less than 16 kg, and hundreds of images can be obtained from one battery charge.

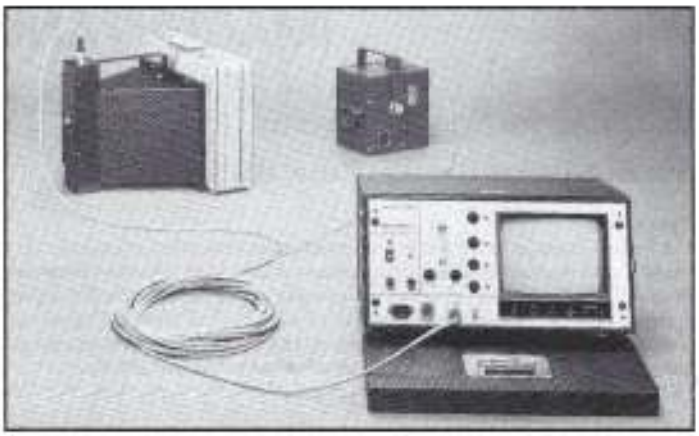
The RTVS/2432 is now being used on robots in the explosive ordnance reconnaissance/EOD role.

RTVS/3648. This larger screen size is useful for examination of full-sized attaché cases, hand luggage and so on, and yet is still easily carried in one hand. In spite of the much larger than normal screen size, excellent detail and penetration are obtained when used with the Six-ray 100 X-ray generator.

In addition to the standard units described, Sector 6 can make special units, using high-power X-ray generators with 140 or 160 kV, 5 mA output, for inspection of such items as steel-carcass truck tyres and other dense objects.

Sector 6 RTVS systems can be used not only for the detection of arms, explosives, contraband and the like, but also in a counter-surveillance role for the detection of hidden microphones, wiring and so on, in furniture, ceilings, partitions and other areas where non-destructive search is a requirement.

The RTVS Mk 4 was introduced in late 1994 with an entirely new viewing unit, little more than half the length of the existing unit but with the same viewing area.



RTVS Mk 3 being used to examine a large briefcase 0516158

Status
Believed to still be available.

Contractor
Sector 6 Technologies.

China

FISCAN CMEX-160190 cargo inspection system

Description
The CMEX-160190 cargo inspection system uses X-ray imaging technology. It is designed to provide high-resolution images for easy object identification using the latest computer control and image processing technology.

Specifications
Weight: 3,000 kg (approximate)
Dimensions:
length: 7.85 m
width: 2.56 m
height: 2.44 m
Tunnel size: 1.65 m wide × 1.925 m high
Penetration: 41 mm steel
Dose per inspection: <1μSv
Radiation leakage: <2μSv at a distance of 50 mm from external housing
Conveyor height: 350 mm
Conveyor speed: 0.2 m/s
Power supply: 380 V AC, 50 Hz

Status
Available.

Contractor
First Research Institute of the Ministry of Public Security.

FISCAN CMEX-B6550 multi-energy X-ray security inspection system

Description
The FISCAN CMEX-B6550 is a multi-energy X-ray security inspection system equipped with state-of-the-art X-ray imaging technology. It provides high-resolution images for easy object identification with the latest technology of computer control and image processing. The unit can distinguish between organic and inorganic materials contained within the inspected articles. With a compact design, it is designed for security inspection of hand-carried articles at airports, customs, railway stations, government buildings, post rooms, courts and other public buildings and areas.

Specifications
Weight: 600 kg
Dimensions:
length: 2.54 m
width: 0.860 m
height: 1.31 m
Tunnel size: 660 mm wide × 500 mm high
Conveyor height: 640 mm
Conveyor speed: 10.2 m/s
Power supply: 220 V, 50 Hz
Penetration: 30 mm steel

FISCAN CMEX-B6550 multi-energy X-ray security inspection system 0568570

Status
Available.

Contractor
First Research Institute of the Ministry of Public Security.

FISCAN EDS-T10080 X-ray explosive detection system

Description
The EDS-T10080 system uses two X-ray generating sets and two detector assemblies for the purpose of detecting explosives at baggage check-in. It employs digital image processing to provide the user with high resolution imagery.

The system can detect explosives such as TNT, C4, Semtex, emulsion explosives, black gunpowder, smokeless gunpowder and nitrate explosives. The user can expand the database of explosives through the system's database management system.

The EDS-T10080 has met the TSA/FAA Advance Technology machine requirements for explosive detection and has been accepted by the TSA/FAA for airport baggage screening.

Specifications
Weight: 2,200 kg (approximate)
Dimensions:
length: 3.3 m
width: 1.32 m
height: 1.91 m
Tunnel size: 1 m wide × 0.8 m high
Conveyor height: 500 mm (approximate)

Conveyor speed: 0.5 m/s (approximate)
X-ray generators' anode voltage: 75 kV, 150 kV
Penetration: 32 mm steel
Image resolution: 1,024 × 768
Max load: 180 kg
Throughput rate: approx 1,800 baggage/hour
Operating temperature: 0 to +45°C

Status
Available.

Contractor
First Research Institute of the Ministry of Public Security.

FISCAN SMEX-V8065B multi-energy X-ray inspection system

Description
The SMEX-V8065B system provides high resolution imagery for easy identification of suspect objects. With a large tunnel size but little height above the ground, it can handle large items and is designed for use at airports, customs posts, ports, railway stations, warehouses and other threatened buildings and areas. The equipment can distinguish between organic and inorganic materials within inspected items, the X-ray image being coloured according to the composition of the material (organic material (orange), inorganic material (blue) and light metal and mixed material (green)).

Specifications
Weight: 760 kg (approximate)
Dimensions
length: 4.0 m
width: 1.07 m
height: 1.55 m

Tunnel size: 0.81 m wide × 0.65 m high
Conveyor height: 280 mm (approximate)
Conveyor speed: 0.23 m/s (approximate)
Max load: 200 kg
X-ray generator's anode voltage: 140 kV
Penetration: 30 mm steel
Dose per inspection: approx 1μSv
Operating temperature: 0°C to +45°C
Storage temperature: –40°C to +70°C

Status
Available.

Contractor
First Research Institute of the Ministry of Public Security.

Germany

CHRONOS electronic stethoscope

Description
The CHRONOS electronic stethoscope is used to detect mechanical time-delay fuzes within improvised explosive and incendiary devices, as well as in military ordnance. It features a high sensitivity filter switch and low noise level. A lightweight set of headphones provide for suppression of ambient noise and the unit comes in a foam rubber-lined transport case.

Specifications
Dimensions, when packed
length: 46 cm
height: 19 cm
width: 32 cm
Weight, when deployed: 6 kg
Weight, when packed: 11 kg

Status
Available.

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.

CHRONOS electronic stethoscope set components (telerob) 0120393

Ebinger EBEX® 2001 series EOD/IEDD stethoscope

Description
The EBEX® 2000 electronic stethoscope was designed for EOD/Improvised Explosive Device Disposal (IEDD) operations. It is used to monitor bombs during render safe procedures by detecting mechanical timing devices which might still be live or reinitiated. The non-contact radar search head is used for the search of concealed IEDs containing mechanical or electrical timers. The detection range depends on the timer position, type and its surroundings.

The stethoscope is used to detect, amplify and to select weak impact sound waves which are below audible levels. The contact probe can detect sound travelling through housing or packing materials such as bomb casings. The non-contact probe detects oscillating objects without interference from airborne noise. Sensor signals are transduced into an electric voltage which is fed to an amplifier with adjustable filters which help to optimise the audio result.

The equipment is easy to operate as the controls are limited to a rotary ON/OFF switch with gain calibration and an adjuster for the filters.

EBEX® 2001 electronic stethoscope components (Ebinger) 0074327

The EBEX® 2000 complete set allows remote listening by a second operator and is supplied in a transit and storage case. The set comprises: main impact sound transducers, underwater probe, non-contact search head, transducer holding plate, wind noise isolator, headsets with a communication system and all necessary straps, cables and reels.

Specifications
Amplifier power supply: 9 V block battery IEC 6 F 22
Amplifier operating time
6 LR 61: 5 h (approximate)
alkaline battery: 20 h (approximate)
Search head power supply: 9.6 V/1.1 Ah Ni-Cd battery
Search head operating time (at 20°C): 8 h (approximate)
Dimensions
Amplifier: 205 × 115 mm
Search head: 240 × 95 mm diameter
Impact sound transducer: 85 × 45 mm diameter
Underwater probe: 85 × 45 mm diameter
Aluminium transit case: 630 × 350 × 175 mm
Frequency (bandpass): 1–5.5 kHz (approximate)
Amplification: 115 dB at 4 kHz (approximate)
Operating temperature range: −15 to +55°C
Weight (complete set with accessories): 14 kg (approximate)

Status
In production and in service.

Contractor
Ebinger Prüf- und Ortungstechnik GmbH.

EBEX® 2001 in transit case (Ebinger) 0074328

Portable stethoscope UST-92

Development
This portable stethoscope is designed to detect mechanical clockwork mechanisms connected to a detonator in a suspect package. It can also be used to monitor discussions through a wall or in the open country, or for the detection of people buried alive after earthquakes, explosions or similar catastrophes.

Description
The stereo stethoscope amplifier is operated in conjunction with a special impact sound sensor. It is suitable for the perception and recording of acoustic signals (speech, noise and so on). Transmitted oscillations, gained from impact sound sensors, are subject to low-noise amplification. Thus even weak signals will be audible.

The UST-92 has a continuously variable amplification control. Using control headphones enables both channels to be audible simultaneously. The balance between the left and right channels can be adjusted. A corresponding line output enables recording on an audio recorder.

Specifications
Audio inputs: 2 inputs for impact sound sensors
Audio outputs: 3.5 mm stereo jack
Amplification setting: 0 – >60dB continuously variable
Headphones output: >32 Ohm

Portable stethoscope UST-92 (Force Ware) 1041278

Power supply
internal: 4 × AA 1.5 V
external: 9–12 V DC
Dimensions: 128 × 23 × 99 mm

Status
In production.

Contractor
Force Ware GmbH.

SPECTIV monocular telescope set

Description
The SPECTIV monocular telescope set is used to view suspicious objects from a safe distance. The set includes a high resolution monocular scope and tripod protected in a rigid metal box with foam inlay. Magnification is variable from 20× to 60×; focus is achieved using an adjustment ring.

Specifications
Magnification: 20× to 60× (variable)
Dimensions, when packed
length: 47 cm
height: 18 cm
width: 36 cm
Weight, when packed: 14 kg

Status
Available.

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.

SPECTIV monocular telescope (telerob) 0120996

India

Parcel Viewer

Description

The Parcel Viewer is an ideal tool for the inspection of sealed parcels or packages and detection of concealed weapons, firearms or other prohibited items without opening them. It is specially recommended by the manufacturer for use in high-risk locations such as post offices, ministerial buildings, secretariats, VIP offices, embassies and similar areas where many sealed packages are handled. The Parcel Viewer accommodates packets of 540 × 420 × 280 mm for inspection. However, contents in an area of 200 × 200 mm can be seen as an X-ray picture on a fluorescent screen. The penetration is up to 1 mm thickness of steel.

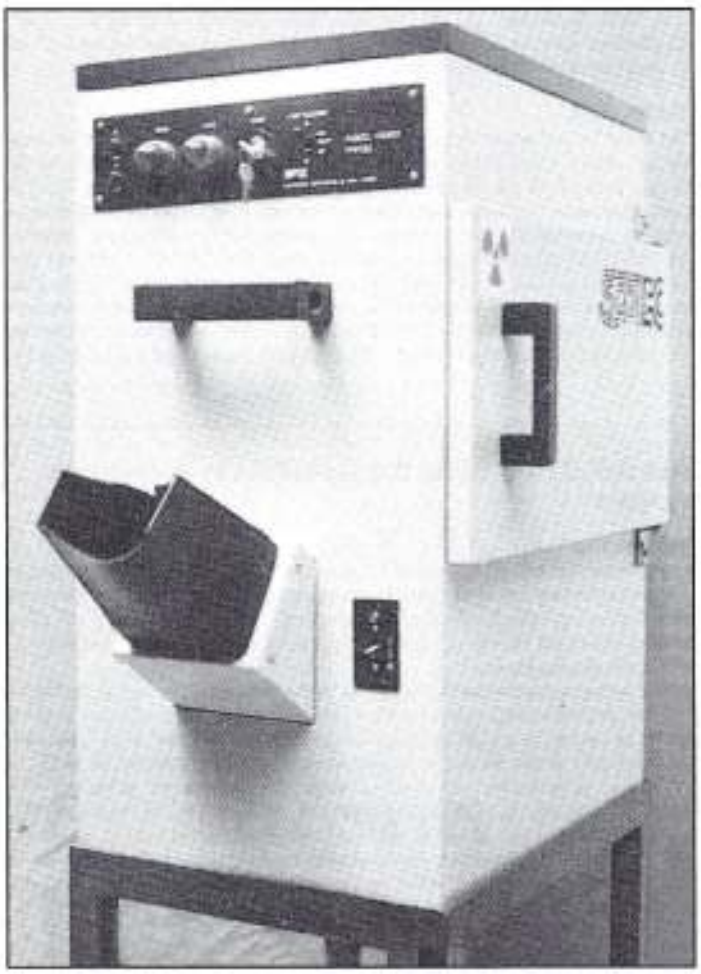
The Parcel Viewer consists of a self-contained insulated X-ray generator and the tube anode with an external radiator cooled by a force fan. The viewing window consists of a lead glass, thoroughly transparent to light but X-ray resistant. A flexible rubber viewing-hood facilitates easy viewing even under normal illumination and the lead-lined steel door is provided with an electrical safety interlock to prevent X-ray leakage. The Parcel Viewer can be mounted on a small motorised trolley for use as a mobile facility for inspection of packages at various locations.

Status

Current status unknown. In service in India.

Contractor

Electronics Corporation of India Limited.



ECIL Parcel Viewer
0023311

Israel

A-600 portable video-based X-ray inspection system

Description

The A-600 portable video-based X-ray inspection system is a lightweight, portable, fluoroscopic unit used for EOD/IED inspection. The complete system – the Control and Display Unit (CDU), the Video Camera Unit (VCU), the cable assembly and the Golden Inspector, is easily accommodated in two portable ruggedised cases.

The A-600 can be used in conjunction with any conventional pulse or continuous X-ray source, ensuring cost-effective customer flexibility. The Golden Inspector 200 version has 16 exposure settings to allow for the most effective and optimum picture quality.

The system captures, displays and stores four images in its internal memory, allowing the user real-time comparison. The A-600 has an internal memory back-up battery which keeps the images in memory for future off-site study and image recording on VCR, video printing or computer downloading.

The system has a high penetration level, as well as the ability to define even the thinnest of wires (36 AWG copper wire). It penetrates 7 mm steel or 30 mm aluminium plate (with Golden Inspector 200). There is an internal battery and charger that provides up to 2.5 hours of continuous operation.

Complete A-600 system showing CDU, VDU and Golden Inspector 200
0023313

Specifications

Resolution: 0.16 mm (36 AWG) copper wire (tested with Golden Inspector)
Penetrations: 7 mm steel plate; 30 mm aluminium plate
Power source: 10 to 30 V DC (external); 85–240 V AC

Dimensions and weight (excl carrying case)
VCU: 395 × 495 × 175 mm – 6.9 kg
CDU: 220 × 260 × 310 mm – 9.2 kg

Carrying cases
VCU: 700 × 220 × 480 mm
CDU: 390 × 410 × 330 mm

Environmental
Humidity: 20–80%
Temperature: –5 to +45°C
MTBF: >17,000 h

Status

No longer in production.

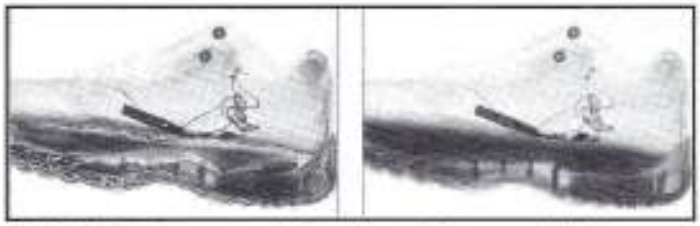
Contractor

Vidisco Limited.

Field Dual Energy System

Development
The Field Dual Energy System was developed to highlight organic substances such as drugs, explosives and inorganic substances such as knives, batteries and detonators.

Description
The Field Dual Energy System is a small, battery operated portable dual energy X-ray inspection system offering high resolution and dynamic range. Similar to stationary X-ray inspection systems used in the air-travel industry, the Field Dual Energy System can perform dual energy imaging without the use of filters. A portable, battery powered, variable energy X-ray source is used in combination with Vidisco software and hardware to produce both dual energy X-rays and traditional high quality black and white X-ray images. The use of a dual energy system enables different substances to be identified as inorganic or organic materials. The programme can then colour these items to make them more visible to the operator and to provide an indication of the threat level or probability of illegal contraband.



The Field Dual Energy portable X-ray inspection system (Vidisco) 1041258

Status
In production.

Contractor
Vidisco Limited.

Flat *fo*X-17 portable flat panel X-ray inspection system

Description
The Vidisco Flat *fo*X-17 flat panel X-ray inspection system uses Amorphous Silicon (a-Si) flat panel technology to package an entire system into one small carrying case for field operation and portability. The system uses battery powered Golden Pulsed X-ray sources and can be used with or without external power.

The system comprises: Vidsico flat panel imager, 50 m of lightweight coiled cable on a reel, a state-of-the-art laptop computer and X-ray source. All components are packaged in a weatherproof 'Storm' case with roll-away wheels which serves as a protective operating platform as well.

Vidisco proprietary software drives the hardware allowing for immediate image reception and analysis. Images can be enhanced by using a wide variety of tools, and can be saved to the built-in database that automatically records a range of information without the user having to physically enter most of the data. The user can add annotations, directly to the image if required. The database can be sorted and queried.

Specifications
Control display unit
Screen: TFT active matrix with 16.7 million colours
Processor: Core™ 2 Duo
Drives: min 40 GB hard drive, DVD, CD-RW, PC card slots
Image storage: limited only by size of hard drive
Power source: auto sensing AC power supply 110/220 V AC, 50/60 Hz, over 1 h operation on internal rechargeable batteries.
Operating time: 2 to 3 hours on internal re-chargeable batteries, unlimited on AC power source 110/220 V

Flat foX-17 flat panel inspection system (Vidisco) 1369043

Flat *fo*X Imager
Imaging area: 284 × 406 mm (12 × 16 in)
Image sensor type: large format amorphous Silicon array
Format: 2,240 × 3,200 pixels, 127 µm pixel size
Dimensions: 500 × 366 × 46 mm
Weight: 9 kg
Complete system weight excluding X-ray: approx 39 kg

Status
In production.

Contractor
Vidisco Limited.

*fo*Xray IIe PC-based X-ray inspection system

Description
The lightweight Vidisco *fo*Xray IIe X-ray inspection system comprises a laptop computer (CDU), video camera unit (VCU) (available in three sizes), coiled cable assembly and Golden X-ray source package all fitting into one suitcase that can be transported by one person. The *fo*Xray IIe is a 10 bit CCD-based system.

The system can run for up to 14 days on its internal batteries and operates on almost any available power source (110/220 V AC or 12 V DC vehicle battery with optional inverter). An 'active matrix' TFT screen provides high resolution and a wide range of colours. The system operates in a Windows® XP environment and has an online system manual and menu hints. The system supports numerous languages.

The *fo*Xray IIe will work with any conventional pulsed or continuous X-ray source. Adjustable exposure settings give the operator his choice of time or number of X-ray pulses for optimum picture quality. The system provides for high definition of thin wires (40 AWG) and for penetration of more than 16 mm of steel (using the XR150 or XR200 sources), and more than 28 mm of steel with a 270 kV source (XRS-3).

An optional external video camera allows the user to watch the suspect item in live video mode and a wireless option is also available. The 'one platform' concept allows users to be able to upgrade to flat Amorphous Silicon (a-Si) panels. The system is also available in a backpack version, the *fo*Xray IIe-Trekker (see separate entry).

Specifications
Control display unit
Screen: TFT active matrix with 16.7 million colours (256 gray levels)
Processor: Core™ 2 Duo
Drives: min 40 GB hard drive, DVD/CD-RW, PC card slots
Image storage: limited only by size of hard drive
Power source: rechargeable internal lithium-ion battery and built-in charger providing up to 3 h continuous operation

foXray IIe PC-based X-ray inspection system (Vidisco) 1369044

Video camera unit (VCU 10)
Imaging area: 190 × 254 mm (other sizes available); triple edge imaging
Camera type: high performance CCD (10 bit)
Dimensions
case dimensions: 800 × 540 × 310 mm
video camera unit: 380 × 260 × 140 mm (VCU-10)
Weight
system weight in case: 25.5 kg (excluding x-ray)
video camera unit: 5.45 kg

Status
In production.

Contractor
Vidisco Limited.

*fo*X-Rayzor portable flat panel X-ray inspection system

Description

The Vidisco *fo*X-Rayzor portable flat panel X-ray inspection system uses Amorphous Silicon (a-Si) flat panel technology to package an entire system into one small carrying case for field operation and portability. The system uses battery powered Golden Pulsed X-ray sources and can be used with or without external power.

The *fo*X-Rayzor is similar to the Flat *fo*X-17 (see separate entry) but uses a lightweight, super thin panel imager with an imaging area of approximately 220 × 220 mm. This allows it to be used in confined spaces. The *fo*X-Rayzor imager is 13 mm deep which is thinner than a film cassette.

Vidisco proprietary software drives the hardware allowing for immediate image reception and analysis. Images can be enhanced by using a wide variety of tools, and can be saved to the built-in database that automatically records a range of information without the user having to physically enter most of the data. The user can add annotations, directly to the image if required. The database can be sorted and queried. The system is also available in a backpack.

Specifications

Control display unit
Screen: TFT active matrix with 16.7 million colours
Processor: min Core™ 2 Duo
Drives: min 40 GB hard drive, DVD/CDRW, PC card slots
Image storage: limited only by size of hard drive
Power source: auto sensing AC power supply 110/220 V AC, 50/60 Hz, over 5 h operation on internal rechargeable batteries.
Operating time: 5 hours operation on internal re-chargeable smart lithium ion batteries

fo*X*-Rayzor Imager
Imaging area: 492 cm²
Depth of imager: 13 mm
Image sensor type: large format amorphous Silicon array
Dimensions: 360 × 330 × 13 mm
Complete system weight excluding X-ray: 33 kg
Accessories: optional live video camera (wireless)

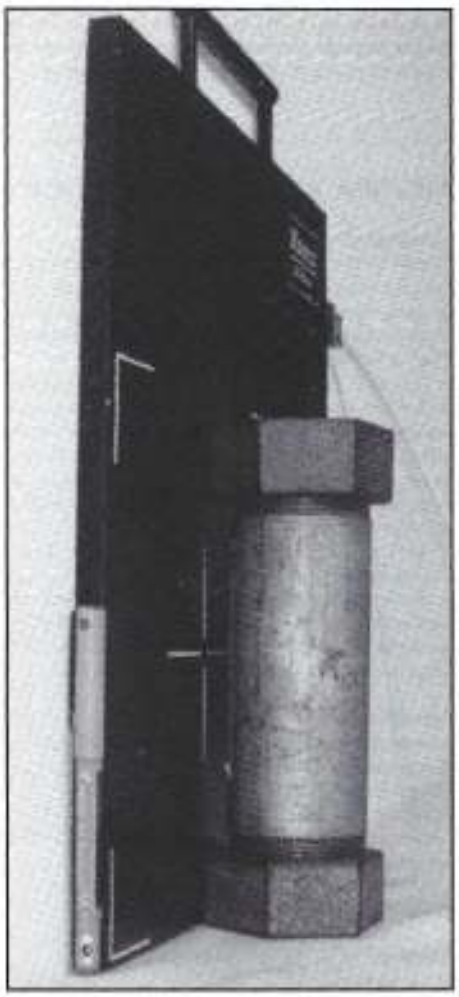
Status

In production.

Contractor

Vidisco Limited.

*fo*X-Rayzor portable flat panel X-ray inspection system (Vidisco) 1041256



*The fo*X-Rayzor flat panel imager is 13 mm deep (Vidisco) 1041257

*fo*X Trekker Ultra Light PC Based X-ray inspection system

Development

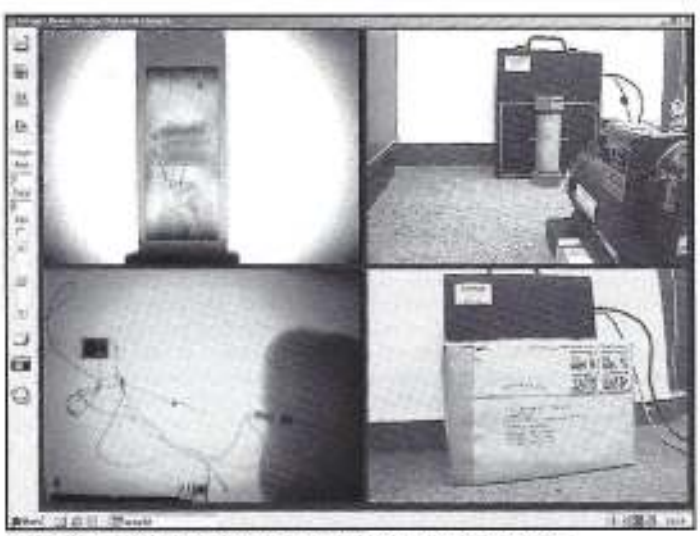
The *fo*X Trekker is specially designed for Commandos and Special Forces operations.

Description

The system is housed in a small backpack weighing 13 kg including the Golden XR150 X-ray source and 50 m of cable.

The *fo*X Trekker works under the Windows® XP operating system and is based on a powerful laptop computer. It has a minimum specification of 866 MHz, a TFT active matrix screen (800 × 600 resolution) supporting 16.7 million colours/256 grey levels and an optional ruggedised computer with sun-readable and touch-screen functions. The *fo*X Trekker is equipped with software that offers a range of tools and options for the user and is capable of operating in numerous languages. The system supports

*fo*X Trekker PC based X-ray inspection system (Vidisco) 0129199



*fo*X Trekker PC based X-ray inspection system screen shots (Vidisco) 0129198

SECTION 4

numerous languages and is currently available in Arabic, Chinese, Czech, Dutch, English, French, German, Hebrew, Italian, Japanese, Polish, Russian, Spanish and more.

The system offers high resolution (40 AWG) and penetration (16 to 28 mm of steel) and has a built-in database and visual library with wireless x-ray and digital wireless video options available.

Specifications

Control display unit
Screen: 214 mm (8.4 in) active matrix TFT colour
Processor: 866 MHz (or equivalent)
Drives: 30 Gbyte hard disk, External CD-RW, built-in modem, Ethernet, Serial, USB and PCMCIA ports
Memory: 256 Mb RAM
Image storage: > 30,000 images in JPEG format
Power source: rechargeable internal lithium battery and built-in charger providing up to 3 h continuous operation

Video Camera Unit (VCU 6)
Imaging area: 153 × 114 mm
Camera type: high performance CCD
Power source: rechargeable nickel metal battery
Dimensions
control display unit: 230 × 190 × 45 mm
video camera unit: 180 × 260 × 97 mm
Weight
control display unit: 1.7 kg
video camera unit: 3.2 kg
total (incl backpack) 13 kg
Cables: 50 m coiled remote cable on reel built into the carrying case.

Status

In production.

Contractor

Vidisco Limited.

MIC-80A X-ray inspection cabinet

Description

The MIC-80A Vidisco inspection system is a video-based X-ray inspection cabinet especially designed for rapid and effective security inspections of mail, handbags, parcels and briefcases. The MIC-80A has a particularly large imaging area (60 × 45 cm) to enable the system to deal with standard sized attaché cases.

The MIC-80A has been designed for ease of operation and sharp, distortion-free viewing and the system displays and stores real-time images in its internal memory. Average exposure time for an image is about 1 second and image exposure is easily adjusted. All functions and viewing of images are performed by the operator, via a few simple controls. Images can be recorded on an optional VCR unit for documentation, or printed on a video printer.

An image enhancement option greatly improves definition of images that are difficult to analyse and a built-in measurement system provides a quick estimation of the size of a suspect object. There is a scroll and pan zoom function enlarging the image by 200 per cent for augmented viewing. A polarity reversal feature allows the operator to switch from negative to positive images and vice versa.

Specifications

Power: AC operating voltage: 110 or 220 V AC
X-ray source: 10 mA at 80 Kv
Dimensions
Cabinet: 75 × 54 × 188 cm (w,d,h)
Cabinet inspection chamber size: 60 × 45 × 55 cm
Imaging area: 60 × 45 cm
Display monitor: 14 in B/W
Weight of cabinet: 280 kg

Status

No longer in production.

Contractor

Vidisco Limited.

MIC-80A X-ray inspection cabinet 0023312

µ-Ray 150 portable video-based X-ray inspection system

Description

The µ-Ray 150 is a portable, lightweight unit designed to give the user a tool for the real-time inspection of any device. The manufacturers claim it is possible to penetrate and define the contents of even the most difficult devices such as pipe bombs.

The complete system comprises a Control and Display Unit (CDU), a Video Camera Unit (VCU), cable assembly and Golden XR-150 accommodated in one portable ruggedised case. The µ-Ray 150 captures, displays and stores four images in its internal memory, allowing the user real-time comparison. The µ-Ray 150 has an internal memory back-up battery which keeps the images in memory for future off-site study and image recording on VCR, video printing or computer downloading.

The system can be used in conjunction with any conventional pulse or continuous X-ray source, ensuring cost-effective customer flexibility. Sixteen exposure settings shown on screen in seconds and pulses, allow for the most effective and optimum picture quality. The µ-Ray 150 has a high penetration level, as well as the ability to define even the thinnest of wires; 38 AWG copper wire. The µ-Ray 150 penetrates 7 mm steel or 30 mm aluminium plate (with Golden Inspector 200).

µ-Ray 150 portable video system in ruggedised case 0004896

Specifications
Dimensions: 274 × 375 × 129 mm (VCU); 200 × 185 × 222 (CDU)
Weight, excl carrying case: 5.3 kg (VCU); 3.8 kg (CDU)
Carrying case dimensions: 575 × 480 × 210 mm
Environmental: 20–80% (humidity); –5 to +45°C (temperature)
Mean time before failure: >18,000 h

Status
No longer in production.

Contractor
Vidisco Limited.

Japan

Borescope Rummage Kit (BRK-2)

Description
The Borescope Rummage Kit (BRK-2) allows the operator to work freely in confined spaces by providing a complete body worn system, including a borescope holster. The BRK-2 incorporates a 16 mm diameter BLR-16 borescope specially designed to provide a high-quality, bright image in large voids. The scope is lateral viewing with a 50° field of view and has an integral light guide cable. The belt-mounted KLS-102 light source included in the kit has been specially modified to accept the larger diameter light guide connector of the BLR-16.

Status
In production and in service worldwide.

Contractor
Olympus Optical Co Limited.

BRK-2 Borescope Rummage Kit
0516550

Russian Federation

Delta-PDI X-ray inspection system

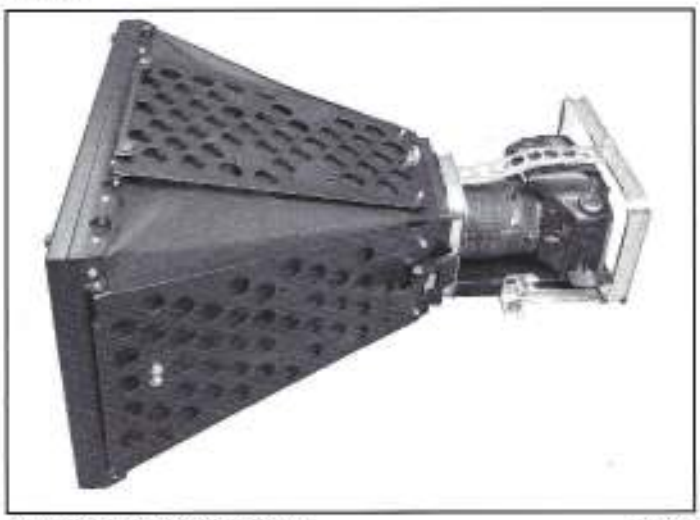
Description
The Delta-PDI is an X-ray inspection system with a portable digitial introscope. The system is primarily designed to provide the ability to analyse objects for the presence of illegitimate devices and their inner structure investigation during various operations.

Introscopy works by the object being able to be studied inside without putting something into it (which is endoscopy). The object is irradiated with x-ray and a shadow picture of items inside can be investigated. The picture will highlight differences in density and other characteristics of items.

The Delta-PDI is a further modernisation of the Delta-160.

The Delta-PDI converter screen resolution is around 5 pairs of lines per 1 mm along the entire converter screen square. This number is matched with the resolution power of the Delta-PDI data recording unit, that is based on the Canon D30 SLR with 8 MP CMOS-matrix (3,504 × 2,336 pixel).

Captured images are processed on a PC and can be stored in a CF memory card of a Canon D30 SLR camera or in PC memory, if it is connected to a converter.



Delta-PDI Converter (STT Group) 1340646

Canon D30 SLR (STT Group) 1340643

For details of the latest updates to ***Jane's Explosive Ordnance Disposal*** online and to discover the additional information available exclusively to online subscribers please visit
jeod.janes.com

Specifications
Lowest recognisable diameter of Cu-wire:
beyond 50 mm of wood: 0.05 mm
beyond 10 mm of steel: 0.32 mm
beyond 100 mm of construction plaster: 0.25 mm
Weight:
X-ray generator: 3,860 g
Power supply unit: 3,200 g
Control unit with cable: 350 g
Converter unit: 2,065 g
Dimensions:
Control unit: 80 × 80 × 20 mm
Converter unit: (operational mode) 380 × 270 × 485 mm
Converter unit: (folded, transportation) 380 × 270 × 50 mm
Digital camera: 180 × 160 × 190 mm
Operating temperature: +5 to +40°C
X-ray generator power supply: AC 220± 20 V/ 50–60 Hz
X-ray beam angle: 40°
X-ray anode current: –1 mA
X-ray anode voltage: 160 kV
Converter:
Screen size: 350 × 230 mm

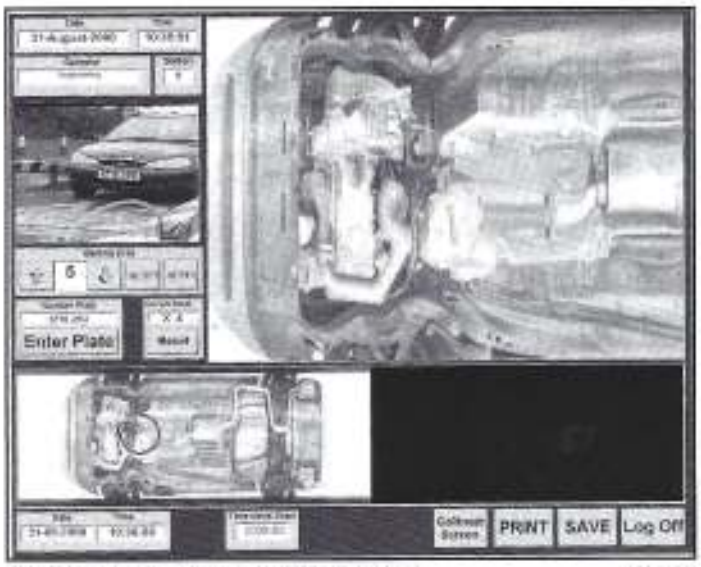
Status
In production.

Contractor
STT Group.

United Kingdom

Colour Under Vehicle Surveillance System (CUVSS) Mobile

Description
The Colour Under Vehicle Surveillance System (CUVSS) Mobile, similar to the BDL Systems' CUVSS Static, is used to check for under-vehicle booby traps and unauthorised modifications or suspicious objects on the underside of vehicles. However, the CUVSS Mobile can be deployed from an estate car (station wagon) and is used to check for Under Vehicle Booby Traps (UVBT) and unauthorised modifications or suspicious objects on the underside of vehicles. The system can view vehicles of any length and weight up to 40 tonnes.



CUVSS typical screen image (BDL Systems) 0546830

Typical system layout (BDL Systems) 0546832

The CUVSS Mobile is mounted within a rugged enclosure, a sectional rubber ramp, for use of the system above ground. An Automatic Number Plate Reader can be incorporated.

It may be particularly useful for vehicle checks at exhibitions, meetings, conferences and so on. BDL Systems can provide a Rapid Deployment Vehicle for specialist applications of the Mobile CUVSS, fitted out to the specifications of the customer.

Status
In production and in service.

Contractor
BDL Systems Limited.

Image obtained (BDL Systems) 0546829

Colour Under Vehicle Surveillance System (CUVSS) Static

Description
The Colour Under Vehicle Surveillance System (CUVSS) Static, similar to the BDL Systems' CUVSS Mobile, is used to check for under-vehicle booby traps and unauthorised modifications or suspicious objects on the underside of vehicles.

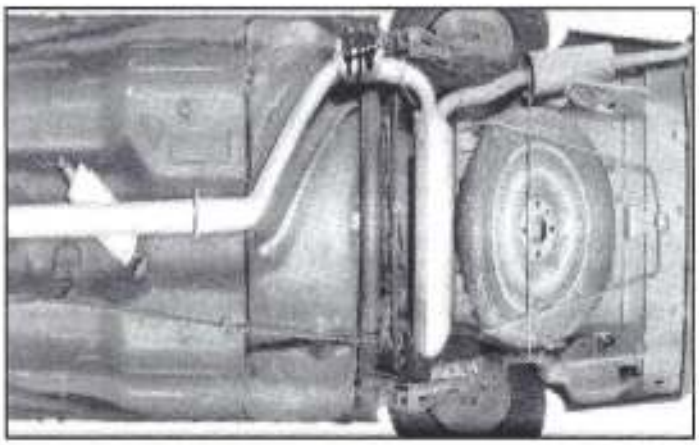
The CUVSS Static provides a clear picture of the underside of vehicles within seconds of the vehicle having driven over the scanning unit, thus allowing bombs and attached packages to be identified much faster and with greater certainty than conventional techniques such as hand-held mirrors.

The camera scanning unit is mounted below the road surface but requires minimal work to install.

The image is displayed on a touch-screen monitor and can be manipulated or zoomed into for closer investigation of the vehicle. The CUVSS system includes a scene camera, which can be used for viewing and displaying the vehicle registration plate alongside the underside image. An automatic number plate reader can also be incorporated.

Status
In production.

Contractor
BDL Systems Limited.



The CUVSS Static is used to check for under-vehicle booby traps (BDL Systems)
0074418

Electronic stethoscope

Description
This sensitive electronic stethoscope is designed for the detection of mechanical run back timers and electronic timing systems in improvised explosive devices. The portable, battery-operated kit comprises a contact sensor, a non-contact sensor, a control unit/amplifier with shoulder strap and noise-suppressing headphones.

The sensitivity of both sensors can be optimised by adjustment of the gain and frequency response. The non-contact sensor, which operates on a Doppler shift principle, is effective through brickwork, wood and plastic.

The kit is shockproof and splash resistant and the lightweight electronic control unit can be shoulder or belt mounted.

All items are supplied in a robust ABS carrying case complete with battery pack, battery recharger and connecting cables.

Specifications
Amplification: 7×10^4
Frequency range (electronics): 500 Hz to 5.5 kHz
Filter: 2–6 kHz
Operating time
contact sensor: 14 h
non-contact sensor: 6 h
Power supply
control unit: 9 V, PP3 battery
non-contact sensor: integral 12 V rechargeable Ni-Cad battery

Status
In production and in service with bomb disposal forces worldwide.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

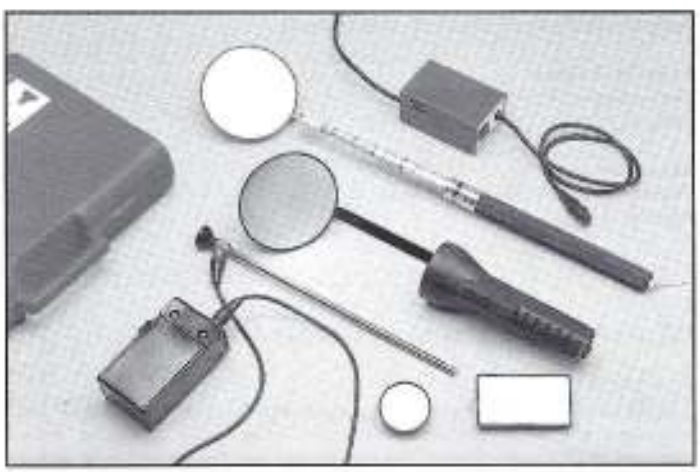
Electronic stethoscope in use (Allen-Vanguard) 1041273

Electronic stethoscope and components (Allen-Vanguard) 1041274

Endoscope and mirror kits

Description
(See separate entry in EOD Tools and Equipment).

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).



Endoscope and mirror kit components (Allen-Vanguard)
0074285

Infra-red telescopic camera

Description
This is a compact and portable infra-red video system for searching buildings, ships and vehicles. It is suitable for use by police, customs officers, military and security forces.

The camera head, incorporating a powerful covert infra-red light source, is mounted on a lightweight telescopic arm that can be extended to 1.6 m. The head passes through a 60 × 65 mm opening and is easily manoeuvred into confined spaces. A swan neck fitting permits adjustments to the angle of view. The high resolution video system and powerful illumination are designed to provide excellent visibility in darkness.

The need to carry out system adjustments during operation is eliminated by use of a fixed focus lens with a large depth of field and automatic gain control that continually optimises image contrast.

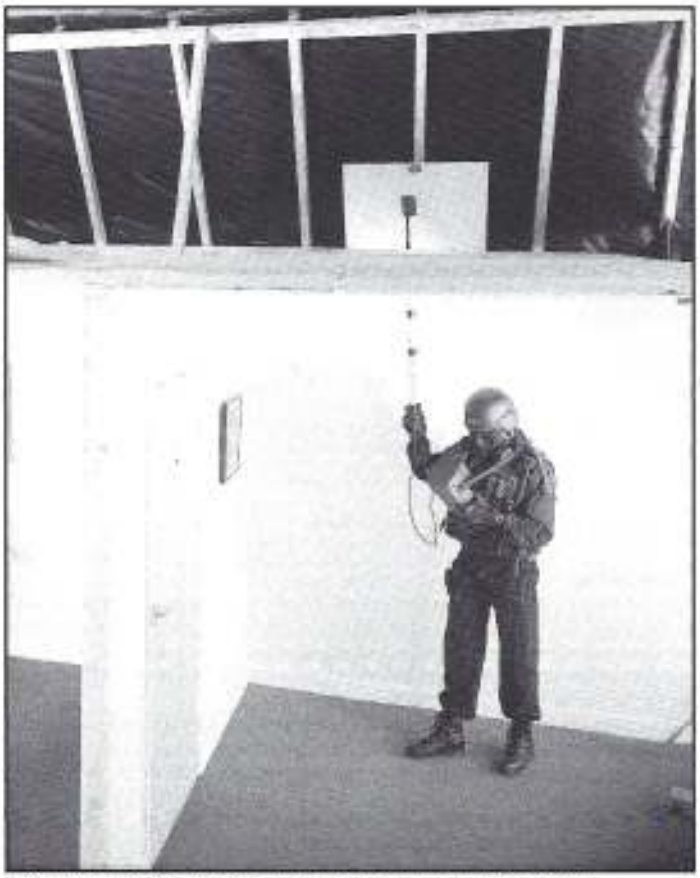
The system is powered by a nickel-metal hydride battery with a fast charging capability. The monitor, battery and controls are located in a compact soft bag that can be worn securely on the chest using neck and waist straps during operations.

Standard video output permits the use of video recording equipment and additional monitors.

The complete system comprises the camera and infra-red light source on a telescopic pole; monitor, rechargeable battery and controls fitted into a soft pouch with neck and waist straps; spare battery pack; battery charger; and transit/storage case.

Specifications
Camera: monochrome, high resolution, high sensitivity
Illumination: infra-red LED array
Monitor: CRT, monochrome, 100 mm screen, 400 lines resolution
Battery: 12 V, 2.2 Ah, Ni/MH, 1 h charge
Operation time: 1 h
Fast charger: Ni/MH 200–240 V AC, 50 Hz or 100–120 V AC, 60 Hz
Camera dimensions: 40 × 50 mm
Telescopic pole
extended: 1.6 m
closed: 0.51 m
Weight: 9 kg

Status
No longer available or in production.



Allen-Vanguard's compact and portable infra-red video system (Allen-Vanguard) 0074294

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

Jack-in-a-Box Mk 3 remote camera system

Description
The Jack-in-a-Box (JIB) remote camera system (Mk 3) is the latest addition to the range of remote control camera systems developed for the remote monitoring of bomb neutralisation techniques and operations. It can be remotely operated from a distance of up to 500 m and is readily portable by one EOD operator.

The system comprises a colour camera on a pan and tilt unit, housed in a compact casing, a cable drum with a standard length of 100 m cable, a colour monitor and a control box. It can be integrated within the picture-in-picture display on the control stations of remote vehicles. Deployment of the system is either by remote vehicle or operator.

Specifications
Camera Case
Dimensions: 368 × 165 × 445 mm
Weight: 7 kg
Colour camera: 24 × zoom digital
Pan/Tilt: 350° Pan; 45° Tilt

Control Unit
Dimensions: 420 × 350 × 180 mm
Weight: 12.5 kg
Frequency: radio 1.4 GHz; data 170 KHz
Range: Radio 300 m; fibre 200 m (standard)

Fibre Optic Drum
Dimensions: 260 × 200 × 220 mm
Weight: 3.4 kg

Accessory case
Dimensions: 420 × 350 × 180 mm
Weight: 6.2 kg

Jack-In-a-Box Mk 3 remote camera system (BDL Systems) 1299202

Status
Available.

Contractor
BDL Systems Limited.

RE 80 M3 EST Electronic Stethoscope

Description
The RE 80 M3 EST is a modular electronic stethoscope designed for both explosive ordnance disposal (EOD) and improvised explosive device disposal (IEDD) applications. The equipment has the capability to pick up and pre-amplify acoustic vibrations which are the basis of sound waves, emanating from mechanical, electro-mechanical and certain electronic fuses and timing devices.

The RE 80 M3 EST also features a Microwave Doppler Contactless Microphone which can also be positioned with a stand off from the device being monitored. The Contactless Microphone can read the signature of a

Components of the RE 80 M3 EST (Richmond EEI Limited) 1334723

range of mechanical and electronic timers. The set comes complete with a miniature sensor which can be taped to various enclosures and a bomb probe sensor which can be used to monitor buried unexploded bombs (UXB).

Specifications
Weight: 28 kg (incl transit case)
Dimensions
Length: 730 mm
Width: 500 mm
Height: 300 mm
NATO stock number: 1385-99-252-8077
Battery: 8 × AA batteries

RE 80 M3 EST in transit case (Richmond EEI Limited) 1334722

Status
In production and in widespread service.

Contractor
Richmond EEI Limited.

RE 650 RTVS Real Time Viewing System

Description
The RE 650 Real Time Viewing System is designed to enable instant viewing of X-Ray shots on location with an easy to use set of man-portable equipment.

The RTVS can be used with a variety of portable X-Ray generators such as the Golden Engineering model XR 200 which makes a particularly suitable combination.

The digital signal processing unit within the electronics features a 'frame grabber' which enables the capture of a frame of video, each time the system is activated. Up to four frames can be held, individually manipulated and stored. Manipulation features include zoom, enhance, pseudo-3D, object measurement and split screen to four windows.

Specifications
RTVS video camera unit (in transit holdall)
Weight: 5 kg
Dimensions: 39 (w) ×21 (d) × 52 (h) cm

RTVS control and display unit
Weight (closed for transit): 12 kg
Dimensions (with closure panels in place): 74 (w) × 52 (d) × 46 (h) cm

Status
In production and in widespread service.

Contractor
Richmond EEI Limited.

Rigid search endoscope kit

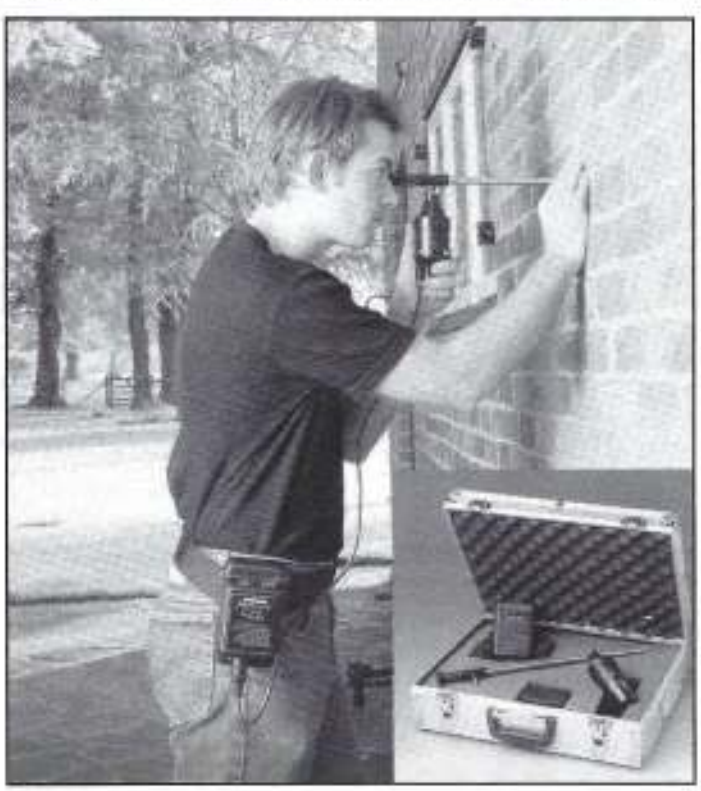
Description
The rigid search endoscope kit has been developed for specialist police, customs and military operators for a wide range of applications including narcotics and contraband detection, explosive ordnance reconnaissance and improvised explosive device search.

The high-quality optics tube is made from rugged stainless steel. It has a diameter of 12 mm and a working length of 300 mm, with a 90° lateral direction of view and a 30° field of view. The focus is fully adjustable from 10 mm to infinity, and the integral high-power fibre-optic lighting provides bright and safe 'cold light' illumination; there is no hot lamp at the tip of the endoscope. The 50 W quartz halogen light source couples directly to the endoscope body and is powered by a belt-mounted battery pack.

The complete equipment package comprises the Knowall rigid endoscope, the LH50 light handle, the LH50BP 2.5 Amp battery pack providing 30 minutes of continuous run time, the LH50BPC 240 V main input charger and a carrying case. Optional accessories are the ZRA3 right angel viewer, the CH-CT-CH lens adaptor for fitting to the front of a standard camera lens and the 32-END35 camera adaptor, a focus lens adaptor which magnifies the image directly from the endoscope to the camera film plane.

Status
Available.

Contractor
SDMS Security Products Limited.



The rigid search endoscope has a wide range of applications
(SDMS Security Products Ltd)
1334753

SECTION 4

Scanmax series X-ray scanners

Description

Scanna Msc produce a range of X-ray scanners designed to screen suspect packages in seconds. The range includes the Scanmax 15, Scanmax 20 and Scanmax 25.

Two viewing options are available: colour or black and white. The Colourscan models have automatic image enhancement, a negative or inverse image option, an 8 × zoom and options for highlighting medium and high density objects.

Items to be checked are placed inside the inspection chamber and the operator presses the X-ray 'on' button. A clear image of the item's contents appears instantly on a screen or monitor. Objects appear in high definition and bomb components such as batteries, detonators and wiring will show up clearly, as will razor blades, syringes and glass.

Scanmax X-ray scanners use very low level x-rays and conform to all international electrical safety standards and are issued with a certified radiation safety and critical examination report upon delivery and installation.

Specifications

	Scanmax 15	Scanmax 20	Scanmax 25
Height	890 mm	1,070 mm	1,615 mm
Width	310 mm	658 mm	430 mm
Depth	500 mm	520 mm	610 mm
Inspection chamber			
height:	340 mm	480 mm	535 mm
width:	300 mm	490 mm	560 mm
depth:	400 mm	450 mm	420 mm
Door opening:	340 × 220 mm	410 × 440 mm	535 × 340 mm
Weight:	114 kg	157 kg	170 kg
Power supply:	110 V, 230 V, 50/60 Hz		

Status

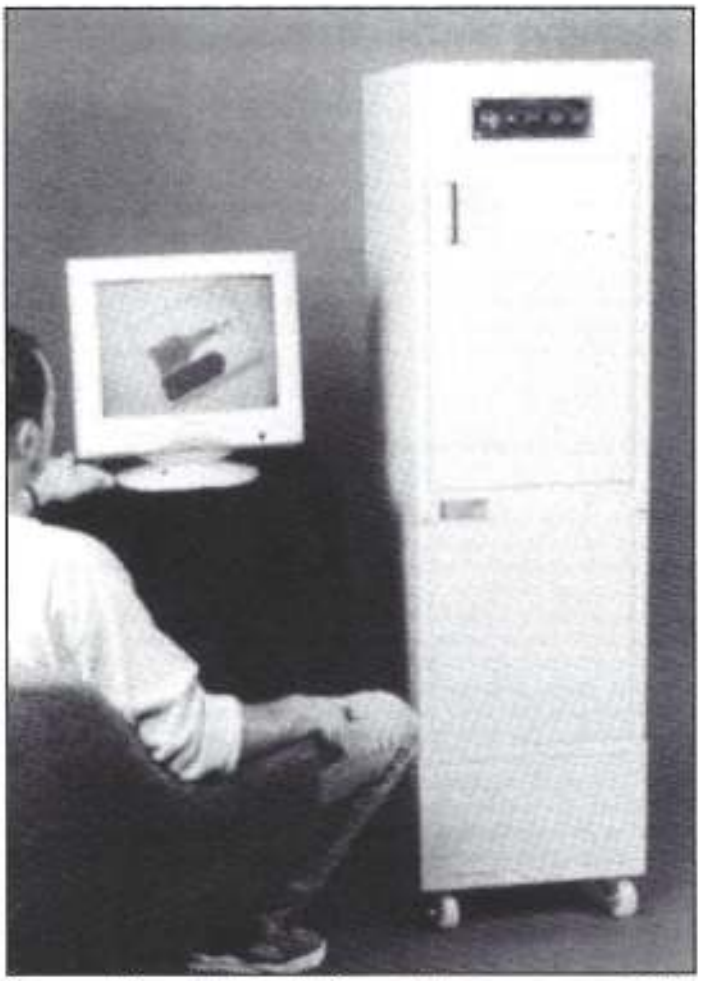
In production and in service.

Contractor

Scanna Msc Limited.

Scanmax 15 floorstanding Colourscan model (Scanna Msc) 0643388

Scanmax 20 floorstanding model (Scanna Msc) 0004704



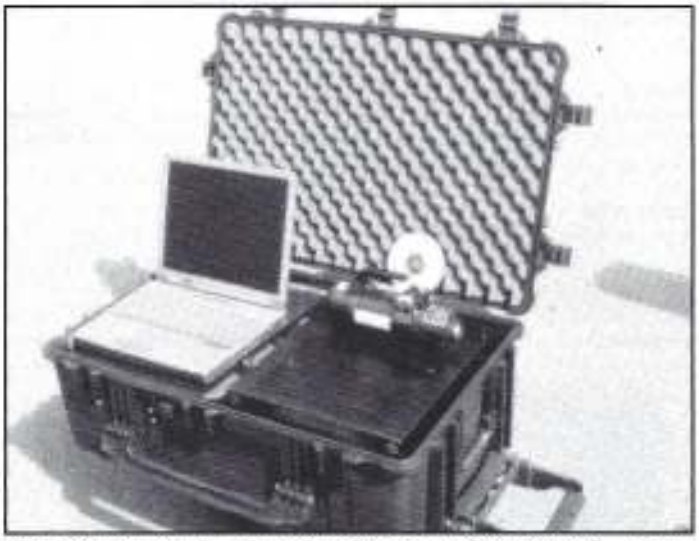
Scanmax 25 floorstanding model (Scanna Msc) 0643387

SCANTRAK portable digital X-ray system

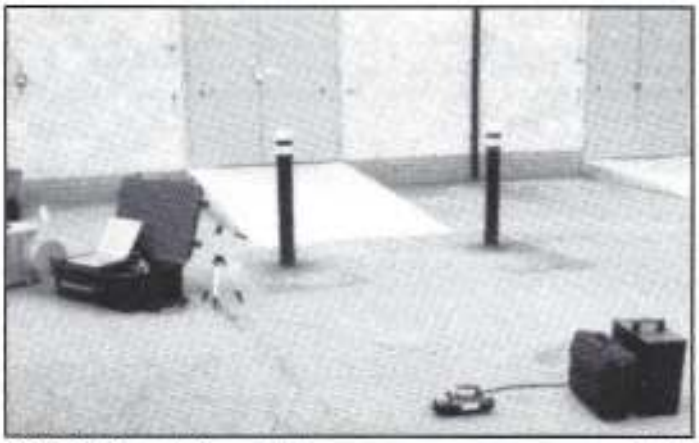
Description

SCANTRAK is a multiple application, portable X-ray viewing system intended for use by police, military, EOD operators, customs, law enforcement agencies, prisons and building security managers in order to search and examine suspect items in situ.

The system can be set up for use in two minutes and works with most portable X-ray sources including the XR150, XR200 and XR-3 as well as some continuous X-ray sources. Image analysis includes zoom, reverse



SCANTRAK component in ruggedised carry case (Scanna Msc) 0543388



SCANTRAK in use (Scanna Msc) 0543389

black and white, pseudo-colour, pseudo-3D and measure. X-ray images can be captured remotely, direct from the notebook PC. Other functions include annotation tools, image print and e-mail. More than 32,000 images can be stored, either on the computer or on CD-ROM. A multi-lingual interface and wireless option are also available. The system can be ruggedised for harsh environments and can be supplied with a range of carry cases.

Specifications
Screen: active matrix 14.1 TFT colour
Processor: Pentium III, Celeron or Duron 900 MHz min
Drives: 10 Gb hard disk, 3.5" floppy, CD-ROM with CD writer
Memory: 128 Mb RAM expandable

Operating system: Windows XP (or Windows 98/NT/ME/2000)
Power supply: 220 V AC 50 Hz or rechargeable battery
Image area
standard: 203 × 254 mm
optional: 254 × 330 mm
custom sizes: available
Camera type: high performance CCD
height: 340 mm
width: 220 mm
Power supply: 110 V, 230 V, 50/60 Hz
Weight: 114 kg

Status
In production and in service.

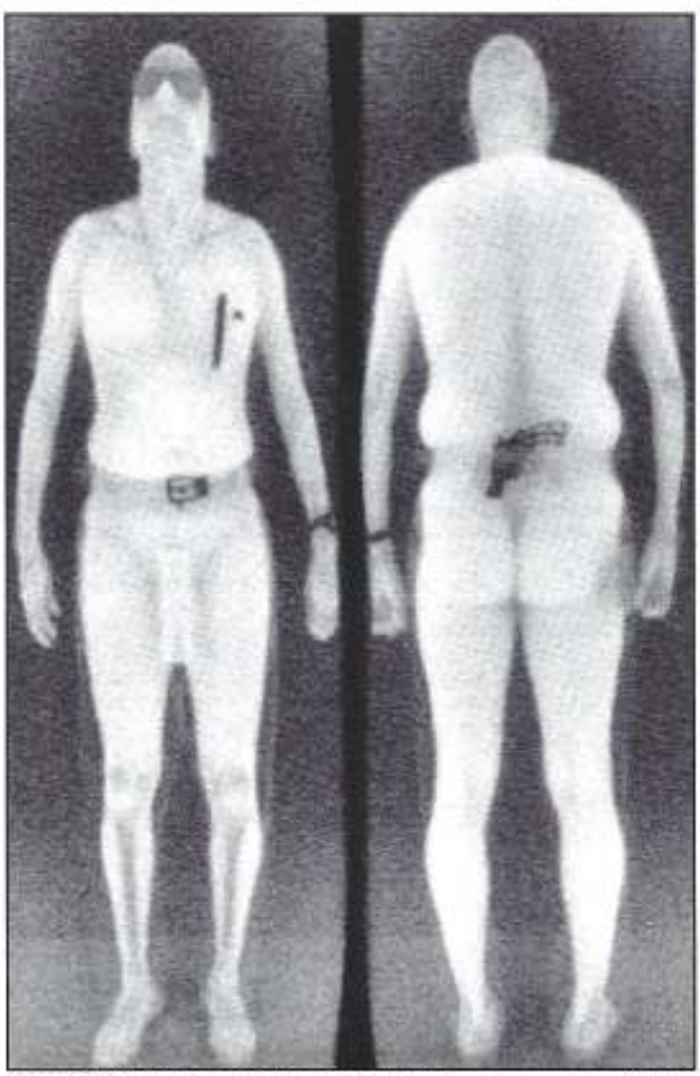
Contractor
Scanna Msc Limited.

Secure 1000™

Description
The Rapiscan Secure 1000™ is a non-intrusive personnel screening system designed to rapidly and accurately image metallic and non-metallic objects concealed on a person's body, enhancing security while reducing the need for physical 'hands-on' searching. The system allows the operator to detect threats by imaging explosive materials such as dynamite, C-4 and Detasheet®, as well as ceramics, graphite fibres, glass vials and even wooden objects.

The individual being screened stands in front of the system for a 6-second front, rear and two side scans. The digital image is immediately displayed on the security operator's computer screen showing the shape and location of objects hidden under the clothing.

Rapiscan Secure 1000 (Rapiscan Systems) 1195841



Secure 1000™ front and back image (Rapiscan) 0543382

The Secure 1000™ operates by scanning the subject with a narrow beam of X-rays. Some of these X-rays will be reflected by the body as backscatter in the opposite direction and be gathered by sensitive X-ray detectors. Advanced image processing algorithms use this information to generate the images.

Specifications
Scan rate: <8 s per view
Display: 432 mm (17 in) high resolution colour monitor
Emission per scan: <10 μREM per scan
Dimensions: 1.23 × 0.92 × 2.02 m
Weight: 499 kg

Status
In service in North America and in Heathrow Airport, UK. Rights to market the Secure 1000 personnel scanner have been purchased from Nicolet Imaging Systems of the US.

Contractor
Rapiscan Security Products Limited.

Snake Cam

Description
Snake Cam is a portable inspection system that combines a miniature CCD camera with a hand-held TFT colour display. The standard inspection camera has in-built cold LED lights and can operate in complete darkness.

Snake Cam is waterproof to a depth of 30 m and can be supplied in an 'immediate use' case for rapid deployment. The compact display unit has a rotating screen enabling the picture to be viewed 'head up', regardless of camera orientation. The standard camera cable can be up to 100 m long and is supplied in modular lengths up to 500 m long. The TFT screen is protected by a Lexan outer cover.

Images can be downloaded for record purposes or for forwarded transmission to others.

Snake Cam can be easily attached to any model of borescope or fibrescope for viewing through small apertures. Numerous optional extras for the Snake Cam are available. These include various mains adaptors and cable extensions, camera adaptors, battery packs and telescopic lightweight carbon fibre camera poles of various lengths.

Specifications
System weight: 1.4 kg
Display unit: 12.7 cm full colour TFT-LCD
Camera: 3 cm diameter CCD camera
Power supply
internal: 2 × 6 V Ni-Mh rechargeable batteries
external: AC nominal 100–240 V, DC nominal 12 V
System operating temperature: 0 to +50°C
Operating time: Up to 45 mins continuous operation by each of 2 × 6 V NIMH rechargeable batteries
Waterproof: 30 m

Status
In production. In service with military and government agencies worldwide, as well as many private companies.

Contractor
Red Box International Limited.

Snake Cam portable miniature search and inspection camera (Red Box) 0077873

T4000 Passive Stand-Off Imaging System

Description
The ThruVision™ T4000 is a real-time, passive terahertz camera. The T4000 collects naturally occurring terahertz waves produced by people and objects to form images of concealed contraband and threat items without revealing anatomical details of the subject being imaged. Both real-time terahertz and CCTV imagery is transferred to the security operator's PC/notebook using a standard Ethernet link, making remote operation possible.

The T4000 can be mounted overtly, or discreetly, on the ceiling, wall or in a vehicle to screen people for both metal and non-metal objects as they pass through natural 'pinch points' such as ticket gates, metal detectors or doorways. The T4000 has applications in corporate, government, transportation and event security operations.

Status
In production.

Contractor
ThruVision Ltd.

ThruVision™ T4000 Passive Stand-Off Imaging System (ThruVision Ltd) 1368871

T5000 Passive Long-Range, Stand-Off Imaging System

Description
The ThruVision™ T5000 is a long-range, real-time, passive terahertz camera designed to detect concealed threat objects at various stand-off distances. Typical installations include customs and border control security, sporting or cultural events.

The T500 was designed to screen for concealed plastics, composites, ceramics, metals and materials that can be crafted to create a suicide bomb or other threat (including liquid explosives). It can also screen for image concealed contraband such as narcotics packages and locate concealed objects that are not picked up by metal detectors.

The T5000 collects naturally occurring terahertz waves produced by people and objects to form images of concealed items without revealing anatomical details of the subject being imaged. Both real-time terahertz and CCTV imagery is transferred to the security operator's PC/notebook using a standard Ethernet link, making remote operation possible. The T5000 is enclosed in a climate-controlled, weather-resistant housing for outdoor operation – it can be mounted in a variety of ways to screen people for both metal and non-metal objects.

Status
In production.

ThruVision™ T5000 Passive Long-Range, Stand-Off Imaging System
(ThruVision Ltd) 1368870

Contractor
ThruVision Ltd.

TR Detector 10

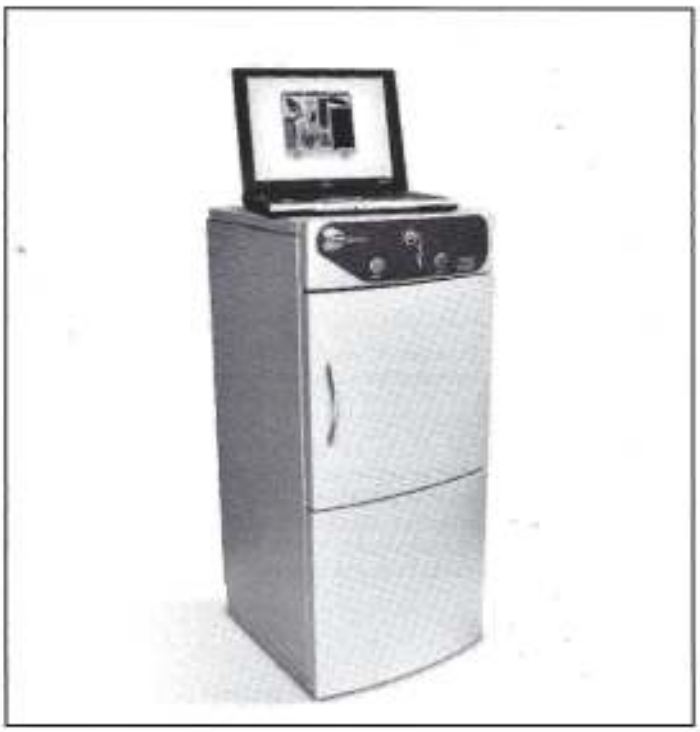
Development
The TR10 model has been designed for situations where the volume of mail or lack of space does not justify the purchase of a larger type of post-room X-ray detector.

Description
The TR10 can examine letters and packets up to 370 mm × 330 mm. It is easy to use, showing the contents of the suspect item in clear details. The items are viewed on a separate monitor which is supplied. It is safe and meets strict radiological safety requirements and installation is simple, requiring only a normal electricity supply socket. The TR10 is delivered and installed by the company's engineers and training is also provided.

Specifications
Height: 920 mm
Width: 430 mm
Depth: 478 mm
Net weight: 75 kg

Status
In production and in service in the UK.

Contractor
Todd Research Limited.



TR Detector 10
(Todd Research Ltd)
1367988

TR Detector 15

Development
The TR15 is the latest generation of detectors for examining letters and small parcels. It includes all the features of the earlier units plus the added advantages of a larger viewing area and a choice of object penetration as well as EPD (enhanced powder detection).

Description
The TR15 provides reliability, speed of operation and object definition. The viewing area is 400 mm × 530 mm. A single push button control creates an immediate X-ray image of the item, assisting the operator to assess its contents correctly. A wall chart illustrating current terrorist mail bombs and other devices helps in this. The equipment is compact, easy to use, safe and like other office equipment and needs only an ordinary mains electrical supply.

Specifications
Height: 1,072 mm
Width: 512 mm
Depth: 426 mm
Power supply: 220/240 V AC, 50–60 Hz, 1 kW: other supply requirements can be met.

Status
In production and in widespread service in the UK.

Contractor
Todd Research Limited.

TR Detector 15
(Todd Research Ltd)
1367989

TR Detector 20

Development
The TR20 (formerly called the TR 2) has been designed for use where space is at a premium but medium volumes of mail are received along with parcels and courier deliveries.

Description
TheTR20 has EPD (enhanced powder detection) along with 16 times zoom. It includes all the features of earlier units plus the added advantages of a larger viewing area and a choice of object penetration. The viewing area is 330 × 330 mm. A single push-button control creates an immediate X-ray image of the item, so assisting the operator to assess its contents correctly. This is helped by a special wall chart illustrating current terrorist mail bomb and other devices. This range has a chamber capacity of 430 × 420 × 380 mm.

Three configurations are currently available: a desk-mounted mirror-viewing model; a free-standing CCTV model with stand-alone monitor; and a Colortrace™ model which incorporates a flat LCD colour screen. The Colortrace™ system technology highlights and defines material densities using colour coding to assist with the identification of specific materials such as plastic explosives, wiring, batteries or chemical compounds. A choice of colour spectrum and a zoom facility aid the identification of potential hazards.

The equipment is compact, easy to use, safe and needs only an ordinary mains electricity supply. Training is minimal and provided by an engineer at the time of install.

Specifications
Height: 1,625 mm
Width: 510 mm
Depth: 425 mm
Power supply: 220/240 V AC, 50-60 Hz, 1 kW; other supply requirements can be met.
Net weight: 160 kg

TR Detector 2 with Colortrace™ system technology and flat LCD screen (Todd Reseach Ltd) 0074800

Status
In widespread service in the UK.

Contractor
Todd Research Limited.

TR Detector 40

Development
Previously named TR Detector 4, the TR Detector 40 was designed in response to a growing demand for a unit with a larger chamber size than the Detector 2.

Description
The high-capacityTR 40 can screen large volumes in seconds. The capacity has been increased to enable a full mailbag to fit in the chamber area. The unit has a multilevel energy adjustment feature and has a number of viewing options. Being a cabinet unit, theTR 40 takes up less space than a conveyor unit and requires only one operator.

Specifications
Height: 1,300 mm
Width: 565 mm
Depth: 565 mm
Power supply: 220/240 V AC 50-60 Hz; other power requirements can be met

Status
In production.

TR Detector 40 (Todd Research Limited) 1367990

Contractor
Todd Research Limited.

TR Detector 70

Development
Previously named the TR Detector 7, the TR Detector 70 X-ray screening unit incorporates modern radiological imaging technology and has been specifically designed to detect anything that may be concealed within mail or personal baggage.

Description
TheTR 70 detects bombs and incendiary devices, weapons, sharp objects and can be specified to alarm for certain materials such as explosives, drugs or money. The system is controlled by an integrated PC operating system and has the potential to install or upgrade software as required. This facilitates a materials recognition feature, which distinguishes different on-screen materials being examined.

A pre-set colour code is displayed when a specific material is detected. Certain colours are assigned to objects of a particular material: orange for organic, blue for inorganic and green for chemicals or mineral.

Specifications
Overall length: 2.40 m (Optional input/output rollers add 0.72 m per set)
Width: 0.9 m
Height: 1.225 m
Chamber capacity: 0.6 × 0.4 m, unlimited length
Power supply: single phase 220 V 50/60 Hz 1,500 VA
Belt speed: 0.2 m/s

TR Detector 70 (Todd Research Limited) 1367991

Status
In production.

Contractor
Todd Research Limited.

TR Micro Detector portable X-ray unit

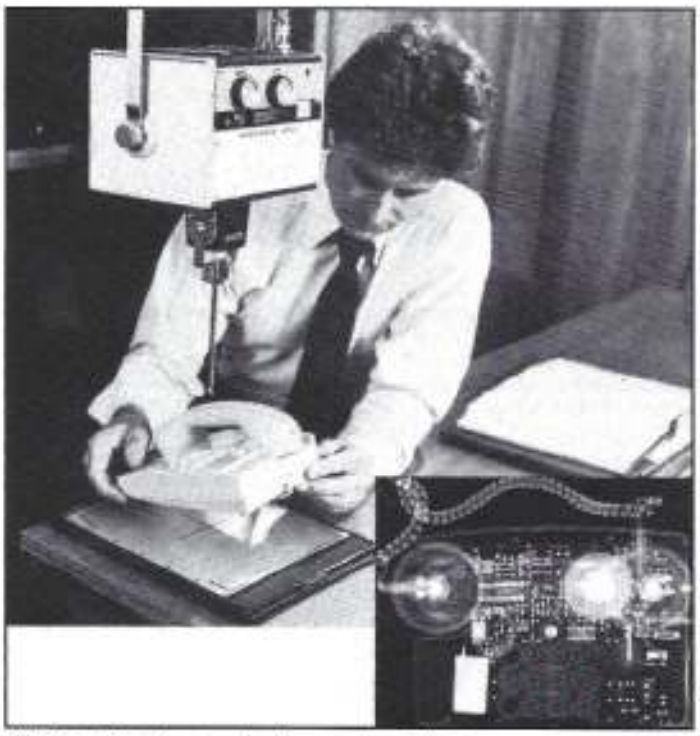
Description
The Micro Detector can be used for many types of internal and external security investigations, including checking office equipment for transmitters or recorders, examining suspect packages in difficult locations and checking vehicles and packages for arms, ammunition, explosives or drugs.

Combining a small X-ray generator with a Polaroid film holder the unit is compact and can be easily moved and placed in difficult positions. It can be powered from any standard mains electrical output point and, if required, a small petrol-electric generator set can be supplied for use in remote areas where no mains supply is available.

Specifications
Inspection area: 200 × 250 mm
Case dimensions: 430 × 210 × 260 mm
Case weight: 12.5 kg
Support stand: 1,100 × 170 × 100 mm
Support stand weight: 7.25 kg
Polaroid processor: 590 × 390 × 340 mm
Processor weight: 16 kg
Operating voltage: 220/240 V AC 50–60 Hz, 5 A; optional transformer for 110 V AC operation, or 240 V generator

Status
No longer in production.

Contractor
Todd Research Limited.



TR Micro Detector preparing to examine a telephone 0515780

TR TransporteX EOD unit

Description
This is a lightweight portable X-ray unit, which views the X-ray image directly with a video camera and transmits the results to a remote monitor. The camera and X-ray source are light and compact and can be positioned easily on each side of the suspect item, allowing examination of an image within minutes of arriving on the scene. The monitor can be located up to 50 m from the camera.

Specifications
Camera
dimensions: 415 × 310 × 375 mm
weight: 10.8 kg
X-ray case
dimensions: 240 × 160 × 300 mm
weight: 8.4 kg
Monitor
dimensions: 270 × 130 × 130 mm
weight: 2.8 kg
Control unit
dimensions: 320 × 135 × 200 mm
weight: 11.2 kg
Operating voltage: 12 V DC from standard car battery

Status
No longer in production.

TR TransporteX EOD unit in use 0516166

Contractor
Todd Research Limited.

Visual search kit

Description
(See separate entry in EOD Tools and Equipment)

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

Visual search kit components (Allen-Vanguard) 1154159

Wireless Inspection Video Kit (RE 1200)

Development
The RE 1200 was developed for conducting search operations under conditions where there is minimal ambient light.

Description
The equipment consists of a video camera and monitor linked via a 1.2 GHz radio channel. The video camera with transmitter and LED light source are installed in a shock-resistant metal case and mounted on a lightweight telescopic arm. The power supply is integrated in the lower part of the arm.

The monitor, receiver and power source are also installed inside a shock-resistant metal case featuring hand grip and flip-out anti glare shades. The hand grip position on the lower arm is adjustable. The kit also features a miniature clip-on trolley with two castor wheels to permit under-vehicle searching.

Six powerful LEDs are used as the light source and are integrated with the camera. An optional infra-red (IR) video head is available on request. The complete set is housed in a soft transit bag featuring foam insets.

Specifications
Three section telescopic arm and extension rod:
(closes to) 2,200 mm
(extends to) 600 mm

Camera type: 1/3 B/W CCD
Camera viewing angle: 120°
Camera resolution: 420 TVL
Sensitivity: 0.05 Lux
Transmitter output power: 70 mW
Video monitor operating time: 2.5 h
Video monitor batteries charging time: 6 h
Video camera, light source and transmitter operating time: up to 20 h
Weight: 6 kg
Operating temperature: −10 to +40°C

Status
In production.

Contractor
Richmond EEI Ltd.

Complete Wireless Inspection Video Kit, including extension rod and clip-on trolley, stowed in transit bag (Richmond EEI Ltd) 1334703

Wireless Inspection Video Kit, RE 1200 (Richmond EEI Ltd) 1334702

XR series of portable X-ray generators

Description
The XR 150, 200 and 300 are pulsed X-ray sources for use with radiographic film or real-time imaging systems. Battery operation and their light weight make the equipment versatile and usable in almost any location.

The equipment only produces radiation while it is pulsing and the integral shielding minimises the amount of radiation outside the 40° X-ray beam. A time delay button and remote firing cable allow the operator to remain at a safe distance from the unit while it is pulsing. Visual and audible indicators on the unit warn when it is in operation.

XR 150 The smallest of the three, the XR 150 weighs under 2 kg, making it suitable for various portable applications such as for helicopter-borne EOD teams and on mini-robotic vehicles.

XR 200 The XR 200 is standard equipment used by EOD/Improvised Explosive Device Disposal (IEDD) teams or for search applications by military, police, customs or security personnel. The updated version of the renowned Inspector 200, the XR 200 is the mainstay of the XR range. Generating 130 KVP from a 14.4 V Ni/Cd battery, the XR 200 provides more penetration than the XR 150 for only 1 kg additional weight. This source is particularly useful in conjunction with real-time image systems such as FoxRay II or RTR.

XR 300 At 300 KVP, the XR 300 is the most powerful flash radiography generator in the range. A hybrid version of the XR 200, the XR 300 has recently been accepted into UK Ministry of Defence service for tasks requiring penetration of dense materials such as plate metals. It has been successfully twinned with emerging 'amorphous screen' technology for optimum imagery analysis.

Specifications
XR 150
dimensions: 265 × 80 × 100 mm
weight: 2 kg
output dose: 1.2 mroentgens/pulse at 300 mm
pulse rate: 6 pulses/s nominal
pulse length: 60 ns
time delay: 15 or 60 s (user selectable)
power supply: 7.2 V removable rechargeable Ni/Cd battery pack

XR 200
dimensions: 320 × 190 × 115 mm
weight: 6 kg
output dose: 2.5 mroentgens/pulse at 250 mm
pulse rate: 23 pulses/s nominal
pulse-length: 60 ns
time delay: optional 15 or 60 s (user selectable)
power supply: 14.4 V removable rechargeable Ni/Cd battery pack

XR 300
dimensions: 318 × 115 × 190 mm
weight: 5.5 kg

XR series of portable X-ray generators (SDS Group Ltd) 0074401

output dose: 30 mroentgens/pulse at 305 mm
pulse rate: 1–99 pulses/s
pulse-length: 50 ns
time delay: 15 or 60 s
power supply: 14.4 V removable rechargeable Ni/Cd battery pack

Status
In production and in service.

XR 300 in transit case (SDS Group Ltd) 0074402

Contractor
SDS Group Limited.

United States

AS&E's MobileSearch™ vehicle and cargo inspection system

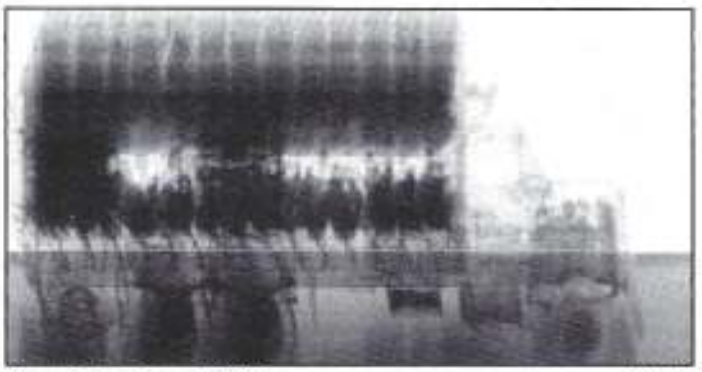
Development
The MobileSearch™ system is designed for the inspection of cargo and vehicles. The system is intended for use by law enforcement officials for anti-terrorism and drug interdiction inspections at sea ports, border crossings and other points of origin.

Description
MobileSearch™ is easily deployed and, once on site, a three-person crew (driver, scan co-ordinator and console operator) can quickly convert to system into its scanning configuration. Target vehicles remain stationary during the scan; vehicles parked nearby are not disturbed. When the inspection process is complete, the X-ray detector folds into its storage cradle for road transport to the next intended usage site.

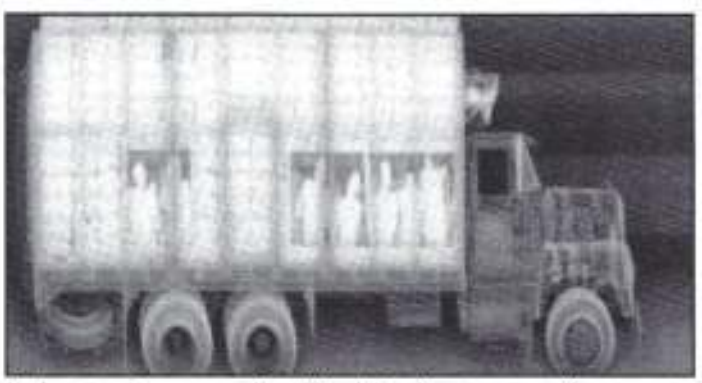
Its ability to move easily from one site to another gives law enforcement officials the element of surprise over potential terrorists, while its large inspection volume permits imaging of bulk cargos. MobileSearch™ is also designed for force protection applications such as facility security and terrorism deterrence.

Propietary Z® backscatter technology is used in combination with traditional transmission imaging. Transmission images offer high resolution and penetration for the detection of high-density materials. Backscatter images provide material discrimination information, allowing for the rapid detection of organic materials. By combining the ability to detect both organic and inorganic materials, the MobileSearch™ system is an effective inspection tool for detecting weapons, plastic explosives, illegal drugs, agricultural products, currency, weapons of mass destruction and other restricted contraband.

Specifications
Operator's console: transmission and Z® backscatter images, 2 × 21 in SVGA colour monitors, 1,600 × 1,200 pixels, 24 bit colour, optical storage disk drive, CD-RW and RAID disk, printer
Image analysis: colour, density expand, edge enhancement, historical compare, reverse video, source rotation, zoom, pan and scroll
Vehicle: left-hand drive
X-ray source: 450 keV source
Scan speed
high throughput: 9.9 m/min
normal: 4.95 m/min
Set-up time: approx. 30 min from arrival on site
'Over-the-road' truck dimensions
length: 10.62 m (34 ft 10 in)
height: 3.68 m (12 ft 1 in)
width: 2.59 m (8 ft 6 in)
weight: 19,545 kg (43,000 lb)
'Deployed for inspection' dimensions
length: 10.49 m (34 ft 5 in)
height: 5.03 m (16 ft 6 in)



Transmission image (AS&E) 0529579



Backscatter image revealing illegal immigrants attempting to enter southern Mexico in a truck-load of bananas (AS&E) 0529580

MobileSearch™ (AS&E) 0077529

width (boom deployed): 6.4 m (21 ft)
width (boom and stairs deployed): 7.62 m (25 ft)
gradient: 2% max

Scanned vehicle dimensions up to
length: 19.8 m (65 ft) for each image data file. Unlimited length in continuous scan mode
height: 4.27 m (14 ft)
width: 2.59 m (8 ft 6 in)

Status
In production. In service in the US and overseas.

Contractor
American Science and Engineering Inc.

AS&E's MobileSearch™ system (AS&E)
0029578

BodySearch™

Development
Terrorists and smugglers use the body and clothing to conceal weapons, drugs and illegal contraband. AS&E's BodySearch™ is designed to detect both metallic and organic threats. It offers a fast, safe and non-intrusive way to screen individuals as they pass through security checkpoints.

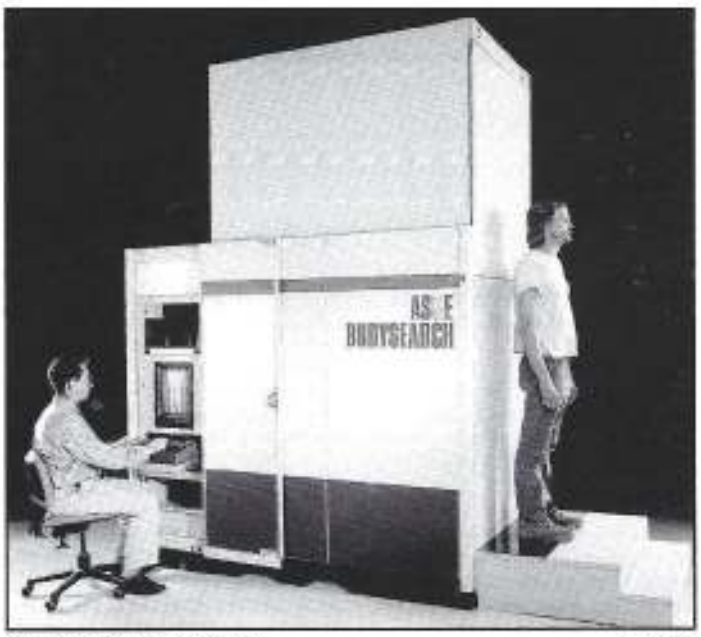
Description
Each scan requires 8 seconds to perform. A comprehensive search of the subject – front, back and side views – is achieved in less than a minute.

The system requires no physical contact between the operator and the subject of the scan. BodySearch™ utilises a collimated MICRO-DOSE® pencil beam to minimise the radiation exposure and ensure a completely safe operation. The system meets all government radiation regulations and poses no danger to pregnant women or individuals with medical conditions. The manufacturer claims that the X-ray dosage of a BodySearch™ scan is so small it would take 7,000 of them to equal the radiation received during one set of typical medical X-rays. Additionally, it is claimed that BodySearch™ causes no harm to film, electronic components or floppy disks.

This is a non-intrusive operation with the person being scanned remaining fully clothed. Only the operator is positioned to view the BodySearch™ images, and facial features are not distinguishable. For further privacy, the unit can be shielded behind a one-way glass and operated remotely.

The majority of potential operators are able to learn the basic operation of the system in a few hours. Images are enlarged or defined by touching a button or movement of a joystick.

BodySearch™ has the capacity to scan a person weighing in excess of 136 kg (300 lb), and standing 198 cm (6 ft 6 in) tall. In its fully operational mode, the unit is 305 cm (120 in) high, 322 cm (127 in) long and 117 cm (46 in) wide.



BodySearch™ in operation 0023329

Status
Available.

Contractor
American Science and Engineering Inc.

Cyclops

Description
Cyclops is a light, portable, full-colour viewing system. Its 33 mm diameter camera can operate over 300 m away from the display unit, utilising a variety of cables, wands and flexible conduit attachments. It can also operate up to near 50 m underwater. The camera can be attached to a VCR or camcorder for recording and can run either on batteries, or AC or DC mains power. The 12.7 cm colour TFT-LCD rotating display is water-resistant and has a 3-level camera light control (low, medium or high).

The Total Access Cyclops package consists of the display unit, the camera, a C-mount camera to adapt Cyclops to fibrescopes and borescopes, a 1.2 m cable, a rigid wand adaptor, a finger adaptor, two Ni-Mh batteries, a battery charger, an AC adaptor, A DC auto adaptor and a carrying case. The Cyclops package also can be supplemented by a number of accessories such as extension cables, various length telescoping wands, neck strap and sun shield.

Specifications
Camera
length: 48 mm
diameter: 33 mm
depth of field: 3.8 cm to ∞
display unit: 12.7 cm
Power
Battery: up to 60 min continuous 6V NiMH rechargeable batteries Battery fast charger AC/DC Adapter and 12v Auto adapter

Status
Available.

Contractor
SAS R&D Services.

Gemini x-ray inspection system

Development
The Gemini x-ray inspection system was designed for use in high-threat facilities, airports and other security-sensitive areas where superior detection is of primary importance.

Description
The Gemini x-ray inspection system combines dual-energy transmission with Z™ Backscatter® technology for comprehensive threat-detection. It combines advanced, commercially-proven methods in a multi-technology system. The dual-energy transmission X-ray easily detects metallic objects such as knives and guns. Gemini's transmission image quality also allows the user to see fine details, such as small wires that may be the components of an improvised explosive device (IED). In addition, dual-energy provides information about material type, especially in uncluttered environments. The Z™ Backscatter® X-ray offers an additional image of the parcel and highlights organic materials such as sheet explosives, bulk explosives and narcotics. Its photo-like images are easy to interpret, especially in the cluttered environment typical to suitcases, briefcases and purses.

Specifications
Imagery
Gray levels visible: 16,000
Wire resolution: 40 AWG
Steel penetration: 30 mm
Computing
Operating system: Windows XP
Processor: 3 GHz Pentium IV
Hard drive: 80 Gbyte

Status
In production.

Contractor
American Science and Engineering Inc.

Gemini x-ray inspection system
(American Science and Engineering Inc)
1279802

ImageX digital X-ray imaging system

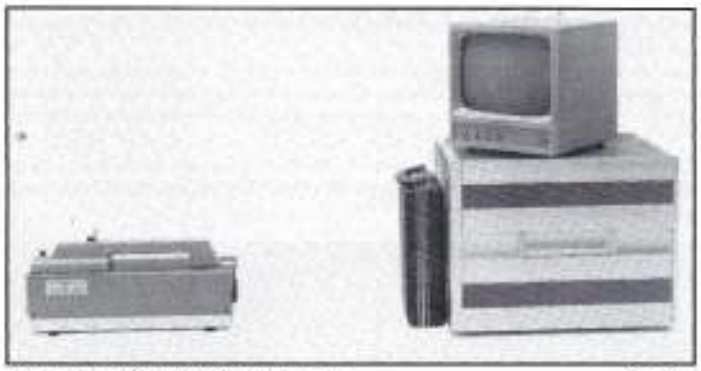
Description
ImageX represents the latest in digital X-ray technology in portable X-ray systems designed for high-level security applications. Instant high-resolution images are obtained from both pulsed and continuous duty X-ray units.

Real-time X-ray images are digitised and displayed without flickering on a high-resolution monitor in less than 1 second, providing the operator with a high degree of safety and extended equipment life and reliability.

ImageX offers the added advantage of being able to compare a real-time image with the last stored image, an especially useful feature in EOD applications.

Specifications
Digital imager
Viewing area: 383 × 383 mm
Resolution: 38 AWG solid gold wire
Image resolution: 512 × 512-768 × 480 pixels
Grey level: 8 bits, 256 shades
Input voltage: 24 V AC
Weight: 3.60 kg

X-ray generator
Output voltage: 150 kVp–50 ns pulse
Output dose: 3.5 mrad at 1 ft/pulse
Window filtration: 2 mm Al
Input voltage: 120/220 V AC, 50 Hz
Battery: rechargeable Ni/Cd with spare
Trigger: time delay and remote
Weight: 9.30 kg



ImageX digital X-ray system in use 0515796

AC/DC modular power supply
Input: 110/220 V AC, 50 Hz
Output: 117 V AC, 5% RMS
Receptacles: 4, with EMI surge protection
Battery: 12 V 10 Ah, sealed
Weight: 10 kg

Status
No longer in production.

Contractor
Distributed by: Security Defense Systems Corporation.

Linescan® 215 series baggage screening system

Development
The Linescan® 215 series of baggage screening systems were designed for use in embassies, mail-rooms, government buildings, courtrooms, correctional facilities and commercial businesses requiring screening of small parcels. The series is especially suited for screening carry-on baggage at airports or any place where floor space is limited.

Description
This Linescan® 215 series is of contemporary design, offering a compact appearance compatible with commercial interiors. These systems offer 'E-SCAN' so that organic materials such as plastic explosives and narcotics are displayed in shades of orange and inorganic materials such as steel are displayed in blue. Objects too dense to penetrate are shown in green. A side-mounted control panel of the latest design features water-resistant membrane keys. Options available at additional cost include operator assist, image arching and image projection. The systems have a tunnel opening of 610 mm wide by 468 mm high.

Linescan® System 215 baggage screening system (L-3 Communications)
0532033

Variants
Linescan® 215
This is the first in the series which offers short conveyors and a single monitor.

Linescan® 215/III
The Linescan 215/III has added features and flexibility such as variable length conveyors and dual monitors.

Linescan® 215/V
This system is PC based and includes Electrical Distribution Box (EDB) which provides management of power distribution. This system allows various computer options such as Threat Image Projection (TIP), Operator Assist (OA) and Image Archiving (IA).

Specifications
Conveyor height:
(standard) 635 mm
(optional) 792 mm

Power requirements:
60 Hz 115–120 V AC, (15 A max)
50 Hz 230–240 V AC, (10 A max)
Conveyor speed:
60 Hz 0.23 m per sec (45 ft per min)
50 Hz 0.18 m per sec (36 ft per min)
Conveyor capacity: 68 kg
Operating temperature: 0 to +40°C
Storage temperature: –20 to +70°C
Weight:
(crated) approx 727 kg
(uncrated) approx 591 kg

Status
In production and in service.

Contractor
L-3 Communications Security and Detection Systems (formerly EG&G Astrophysics).

MailSafex desktop security mail/parcel screening system

Development
The MailSafex desktop security mail/parcel is designed for use in prisons, law enforcement, customs and other high-security applications.

Description
The SDS MailSafex has now been made portable with the introduction of the new flat pack X-ray generator. The desktop design, simple operation and large inspection chamber provide for mail inspection exceeding 3,000 pieces/h. The operator is presented with a clear real-time X-ray image of the contents of all inspected materials. In addition to mail and packages, MailSafex is ideal for examining hand-carried baggage and express or similar deliveries which often circumvent the in-house post room system.

The high-energy, hermetically sealed X-ray generator offers the advantage of greater penetration of dense objects and increased image resolution and sensitivity. Total examination time is less than 5 seconds per item being inspected.

MailSafex desktop screening system 0515790

Specifications
Dimensions: 765 × 561 × 561 mm
Weight: 86 kg
Aperture: 280 × 357 mm
Image area: 357 × 408 mm
X-ray generator: 90 kV, 15 mA, 110/220 V AC 50/60 Hz, 3 A
X-ray tube: fine focus 0.5 mm focal spot, 70° beam angle, 1.0 mm Al filtration
Resolution: 38-gauge wire; meets FAA requirements

Status
No longer in production.

Contractor
Distributed by: Security Defense Systems Corporation.

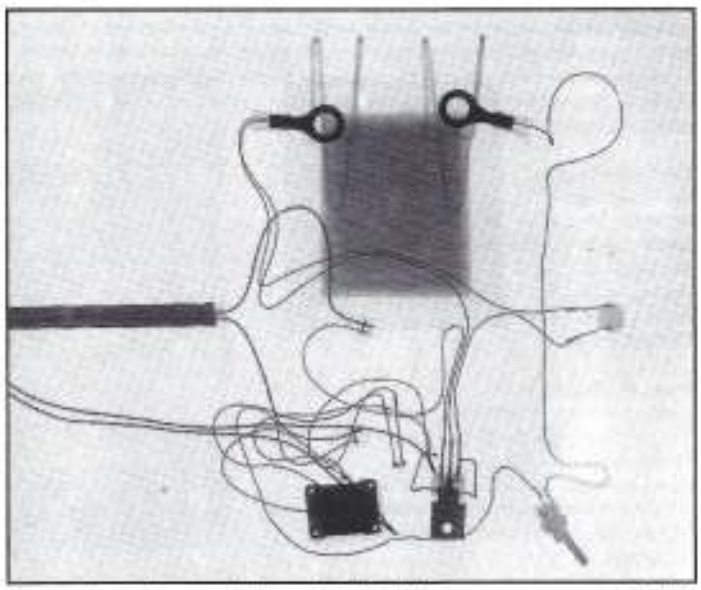


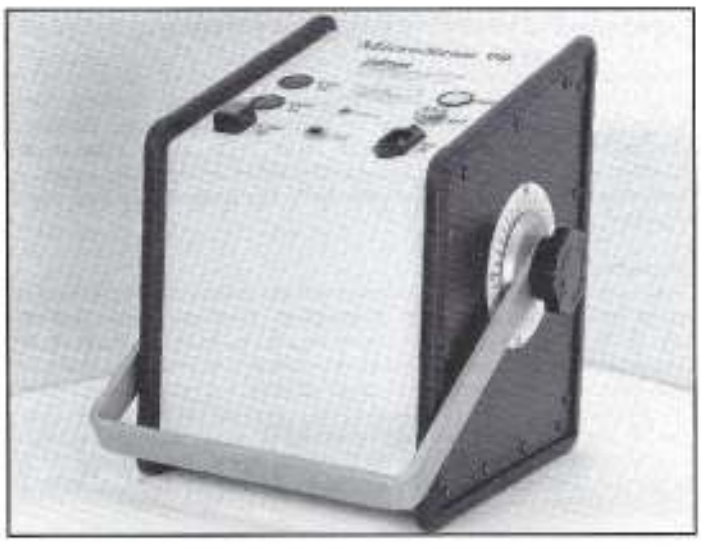
Image of envelope containing simulated IED 0515791

MicroScan 90 EOD X-ray source

Development
The MicroScan 90 EOD X-ray source is a metal and hand-held weapons detector for courthouse, prison, jail, airport and related security applications.

Description
MicroScan 90 is an economically priced portable high-energy X-ray source for EOD bomb disposal applications. It provides high-resolution X-ray images on Polaroid film, VideoVision and ImageX imagers, image intensifiers and Image Storage Panels. The equipment can be set up easily in minutes and powered by any conventional 120/220 V AC 60/50 Hz source. A battery power pack provides another option.

Specifications
Output voltages: 90 kVp–15 mA
Focal spot: 1.0 mm
Window filtration: 2 mm Al


MicroScan 90 EOD X-ray source
0515795

Beam angle: 70°
Sensitivity: 38 AWG
Indicators: Power on; X-ray on
Operation: remote trigger
Optional: battery power pack

Status
No longer in production.

Contractor
Distributed by: Security Defense Systems Corporation.

Mobile VACIS™ Inspection System

Development
SAIC's Mobile VACIS unit is a truck-mounted gamma ray imaging system designed to non-intrusively inspect the contents of trucks, containers, cargo and passenger vehicles for explosive devices and/or contraband.

Description
The Mobile VACIS unit provides maximum flexibility for a variety of different requirements including contraband interdiction, seaport container inspection, explosive vehicle detection and detection of stolen goods. Operators viewing the radiographic images of scanned cargo are able to identify hidden compartments associated with the transportation of explosives, weapons and other threats.

The system can be set up in approximately 10 minutes. Scanning of a 40 ft container can be carried out in approximately 6 seconds, with average cycle times of 1 to 3 minutes per container. Mobile VACIS scanning can be performed on either a stationary or moving object in forward or reverse direction. The gamma image and a video image of the target vehicle are then stored in the on-board computer for further review and analysis.

The Mobile VACIS unit uses gamma rays, rather than X-rays, which allows for an overall lower cost, smaller operating space and safer operation. Object penetration is approximately 102 to 159 mm of steel, depending upon configuration.

The system can be used in all weathers and lights are provided for night-time operation. An on-board generator is capable of delivering power for the whole system. The detectors are loaded in rugged foam support to provide vibration, shock and temperature protection. The source, mounted on a retractable boom, is secured in the travel mode in a rugged lead-lined storage box. The unit is a registered device in compliance with US Nuclear Regulatory Commission (NRC) requirements. The Device Registry No. is CA-215-D-110S. 12 V batteries maintained by the truck charging system provide permanent power for controls and safety systems.

The Mobile VACIS unit is capable of inspecting both stationary and moving vehicles (SAIC)
0569503

Specifications
Spatial resolution: approx 25.47 mm
Penetration
1.0-Ci Cs-137 source: 102 mm of steel
0.75-Ci Co-60 source: 158 mm of steel
Temperature range: –30 to +50°C
Footprint
deployed: 9.15 m × target length
stowed: 9 × 2.44 m
Overhead clearance for boom: 5.8 m
Stowed height: 3.6 m
Source: 1.0-Ci, Caesium-137; 0.75-Ci, Cobalt 60
Wind speed: Operates in conditions up to 64 km/h
Relative humidity: up to 98%

Status
In production and in service. Major customers include Canadian, Jamaica, Malaysian, Mexican and US Customs.

Contractor
Science Applications International Corporation (SAIC).

Model 227 Videoscope

Description
The Model 227 Videoscope has a flexible scope designed to visually inspect remote and difficult to access locations. The capability to articulate the end of the fibrescope greatly enhances its inspection capabilities, allowing the user to direct the instrument around bends and corners. The scope has interchangeable objective lenses for optional fields and depths of view and the shaft is constructed to be watertight such that it can be fully immersed in liquid. The Model 227 is used in other industries, such as the car industry as well as in the security industry for search and detection.

Specifications
Shaft length: 6.09 m (standard) to 10.6 m (maximum)
Focus range: Adjustable 5 mm to ∞
Field of view: 50° standard
Fibre-optic illuminator: 150 W standard

Status
Available.

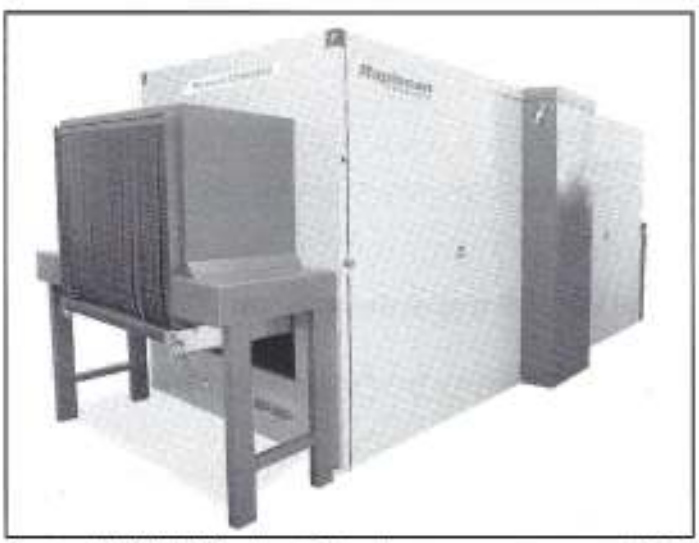
Contractor
SAS R & D Services.

MVXR5000 Hold Baggage Screening system

Description
The Rapiscan MVXR5000 is the latest addition to the range of Rapiscan Hold Baggage Screening (HBS) systems. Multiview (5-view) high quality dual-energy X-ray images enable the advanced automated explosives detection algorithms to provide high levels of detection and image quality and low false alarm rates. The company claims that the one hundred per cent baggage screening is accomplished by the high-speed throughput (up to 1,800 bags per hour) and automated explosives detection capabilities (level 1). The system's gigabyte data transfer capabilities allow near real-time suspicious bag analysis by a networked group of remote operators (level 2). Remote operator analysis is aided by the identification of the potential threat item(s) by the automated detection algorithms. Images can also then be transmitted to the manual inspection stations (level 3) as a search aid, or images can be sent to supervisor workstations for additional analysis.

Status
In service.

Contractor
Rapiscan Security Products Limited.



Rapiscan MVXR5000 (Rapiscan Systems) 1195840

PCSS1 wireless pole camera

Development
The PCSS1 wireless pole camera provides flexibility for tactical teams. The lightweight system has no cumbersome belt pads or external cables.

Description
The PCSS1 can be placed on-target and viewed wirelessly with any Tactical Electronics monitoring option. The small handle assembly houses the wireless transmitter, battery compartment and other electronics required to function. There is no external antenna needed for operation. When an area is not secure for wireless operation, the camera system can be hard wired to the hand-held monitor. Colour and black/white waterproof camera heads are included in the kit. The colour camera head has infra-red LEDs for viewing in dark areas. The black and white camera head also has infra-red LEDs and is suitable for low light or no light situations. Additional light sources can be attached to the mounts on the camera heads. The cameras have a rotating face and flexible neck that ensure maximum viewing at any angle. The monitor is wireless, with no external antennas, cables or battery packs.

Specifications
Weight: 3 lb (includes handle assembly, batteries and one camera head attached)
Length:
(collapsed) 23 in
(expanded) 80 in
Frequency range: 2.4 and 2.485 GHz
Transmission distance: up to one half mile line of sight (increased distance can be added with repeaters)
Camera head water depth: approx 20 m
Batteries: 3 V lithium
Operating time: approx 8 h (with four batteries)
Camera heads: 1 b/w camera with IR LEDs and 1 colour camera with IR LEDs

PCSS1 Wireless Pole Camera (Tactical Electronics) 1334710

Camera head width: 2 in
Effective pixels: 250,000
Light sensitivity:
(colour) 1 lux
(b/w) 0.003 lux
Resolution:
(colour) 350 lines
(b/w) 400 lines
Operating temperature: –10°C to +50°C

Status
In production. In use with various EOD and SWAT teams globally.

Contractor
Tactical Electronics.

PELAN – Pulsed Elemental Analysis with Neutrons

Description
PELAN is a material classification system that can be used to identify explosives, UXO, radiological-based devices, contraband, drugs, chemical agents and landmines. It is non-intrusive and non-destructive, portable and can be rapidly deployed. Operation can be remote, using either a wireless or long cable link.

The PELAN system has a probe that emits short pulses of neutrons that penetrate an object and interact with the nuclei of the chemical elements in the object. From the nuclear interactions, each chemical element (for example, hydrogen, carbon, nitrogen, oxygen and so on) emits characteristic gamma rays that are the 'fingerprints' of each element. By understanding the elemental composition of explosive targets, PELAN IV is able to automatically differentiate and classify suspect targets.

The technology has shown in demonstrations the ability to differentiate anti-tank and anti-personnel mines from shrapnel and other ground anomalies.

An export licence from the US State Department is required prior to export of PELAN or its technical data.

Specifications
Weight: 36.2 kg
Power: standard AC, or lightweight built-in battery pack
Temperature range: –18 to +49°C, 0 to 120°F
Humidity range: up to 95%
Detection speed: typically 5 min

Status
Available.

Contractor
Science Applications International Corporation (SAIC).

PELAN can be used to identify and classify explosive materials (SAIC) 1041254

Portal VACIS® Inspection System

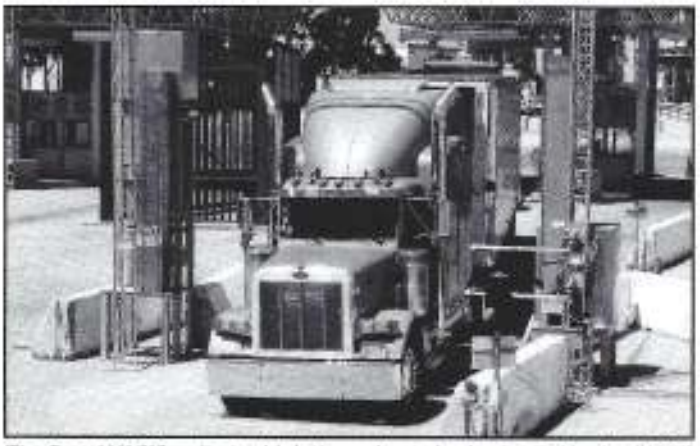
Development
The Portal VACIS unit is a high-throughput system for port gates and roadways.

Description
Engineered to operate with a small footprint, the Portal VACIS unit can be deployed in conjunction with existing vehicle control points, such as weigh scales or gate-stand identification systems. The Portal VACIS system scans entire vehicles from bumper to bumper in the typical flow of checkpoint traffic, reducing the need for manual inspections. The system fits directly into most existing traffic lanes and entry gates, and can be easily networked with other systems via Ethernet connections or operated from a remote command centre or local operating location. As the vehicle leaves the checkpoint, the trailer passes through the scanning region. The system instantly displays the contents of the container, while saving the radioscopic image with a video snapshot of the vehicle licence plate. This saved information is immediately available to enable quick and easy tracking of the vehicle whenever the need arises.

During operation the vehicle pulls forward to place the cabin outside of the beam radiation zone; the driver is not required to leave the vehicle.

Specifications
Power: 120/240 V AC, 50/60 Hz 3 kW per lane
Spatial resolution
standard configuration: ≤51 mm (2.0 in) at the mid-point – centre of the traffic lane
enhanced configuration: ≤26 mm (1.0 in) at the mid-point – centre of the traffic lane
high-resolution configuration: ≤13 mm (0.51 in) at the mid-point- centre of the traffic lane
Penetration
Cs-137: 90 mm
Co-60: 152 mm
Operating temperature
ambient temperature: –30 to +50°C
computer: +15 to +25°C
Vehicle capacity: scan cargo trailers and containers up to 2.6 m wide × 3.7 m high in a single scan
Overhead clearance: 5.02 m min (no limits using underground cabling)
Wind speed: Up to 98%

Status
In production. In service with Mexican Customs; US Customs, US commercial terminal operators and US Department of State.



The Portal VACIS unit at a high-throughput checkpoint in Mexico (SAIC) 0589605

Contractor
Science Applications International Corporation (SAIC).

Rapiscan 500 series baggage screening units

Description
The Rapiscan 500 Series is a comprehensive range of X-ray screening machines suitable for all applications. The systems use the latest computer-based technology to combine high performance with simplicity of use, while ensuring that the system can be upgraded and expanded. All models feature a 43 cm SVGA flicker-free, high-resolution colour monitor. A folded detector array ensures 100 per cent coverage of the full tunnel size.

Rapiscan Crystal Clear™ technology, standard on all 500 Series models, is a selectable computer-automated image optimisation function which gives maximum simultaneous image information, providing high penetration, superb definition and excellent wire resolution.

An option available for most models is Rapiscan EPX (Enhanced Performance X-ray) for the specific detection of explosives, narcotics, gold and currency. EPX can assist operators in identifying substances having the specific characteristics of explosives or narcotics, enabling rapid and consistent detection capability.

To cater for screening larger items such as air cargo, Rapiscan provides models with either 1 × 1 m or 1.2 × 0.8 m tunnel sizes. For large palletised freight weighing up to 3,000 kg a screening tunnel size of either 1.5 × 1.5 m or 1.5 × 1.65 m is recommended.

The latest model is the MVXR5000 with five-view dual-energy X-ray images that can provide high levels of detection (see separate entry). The MVXR5000 has a high throughput of up to 1,800 bags an hour.

Status
In service.

Contractor
Rapiscan Security Products Limited.

The Rapiscan 500 series baggage screening machines all have high-resolution colour monitors (Rapiscan) 0528215

Rapiscan mobile, large cargo and palletised cargo inspection systems

Description
Rapiscan's mobile, large cargo and palletised cargo X-ray inspection systems are designed to screen a range of items from standard pallets up to the largest sea containers and road vehicles. Each model offers common operating interfaces with image enhancement functions. As the size of the cargo increases, the requirements for inspection become more demanding and vary from application to application. Rapiscan design and build systems to meet specific customer requirements, as well as offering a comprehensive range of standard products.

Mobile systems
Rapiscan mobile systems are designed to take advanced X-ray technology on the road. The Rapiscan 4200 Gamma Radiographic Detection System (GaRDS) is a self-contained mobile inspection system for screening trucks, cargo containers and passenger vehicles for contraband and explosives. The GaRDS has an inspection throughput of 1 to 3 trucks with containers per minute at variable scanning speeds. The set-up time for the GaRDS is approximately 10 minutes. The Rapiscan 3345 Mobile Advanced X-ray (MAX) is designed to combine high quality image resolution with improved mobility. This self-contained system can travel to remote areas in severe weather conditions and provides clear, reliable imaging of any size vehicle.

Fixed-site and relocatable systems
These systems are available with flexible throughput options, ranging from 12 vehicles per hour to over 30 per hour depending on the application and growth expectation. The relocatable systems are designed to be moved when necessary, offering an edge over smugglers who are not prepared for checkpoints along their contraband thoroughfares.

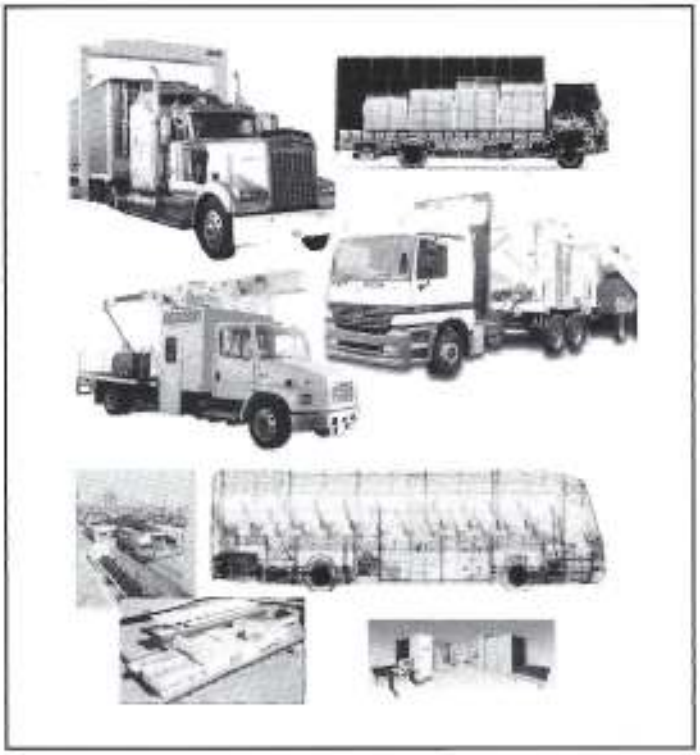
Rapiscan Eagle® Fixed X-ray inspection system
The Rapiscan Eagle® Fixed Site is designed to meet the highest X-ray imaging requirements for cargo inspection. Its 9 MV linear accelerator source delivers a minimum of 425 mm of equivalent steel penetration. It can inspect a wide range of cargo, including densely-loaded trucks and containers. Trucks are automatically moved through a stationary X-ray beam on a cargo motion system. Rapiscan Systems proprietary detector technology creates high quality images, which are presented to multiple inspectors in the facility. The Cargo Viewer software enables the inspectors to analyse the images and find hidden contraband, undeclared cargo, weapons, explosives, drugs and weapons of mass destruction. Built on-site to meet customer requirements, the Rapiscan Eagle® Fixed Site is a turnkey system with capabilities for controlling and monitoring the flow of trucks through the facility, including X-ray and manual inspection operations.

Palletised cargo systems
The Rapiscan 546 has a tunnel opening of 1.8 × 1.7 m enabling the inspection of medium-sized cargo, freight pallets and large parcels. It is available with 320 kV to 450 kV generators; offering steel penetration from 60 mm to over 90 mm. The 546 is also available in a dual-view configuration, allowing simultaneous horizontal and vertical views of scanned objects for improved object discrimination.

Rapiscan Eagle® (Rapiscan Systems) 1195839

Status
In service.

Contractor
Rapiscan Security Products Limited.



Rapiscan mobile, large cargo and palletised cargo X-ray inspection systems (Rapiscan) 0543383

Relocatable VACIS™ vehicle and cargo inspection system

Development
Relocatable VACIS is designed for the non-intrusive inspection of large vehicles, sea containers and other vehicles. Applications include border checkpoint contraband screening; seaport container and truck screening; customs manifest verification and military and high-threat vehicle screening.

Description
Relocatable VACIS uses a proprietary gamma ray imaging technique requiring a very low radiation dose rate. This compares favourably against older techniques using X-rays for large object inspection and means the system can be used without a special protective building or similar enclosure.

The use of gamma rays allows for lower costs, higher system availability, ease of maintenance and a smaller exclusion zone.

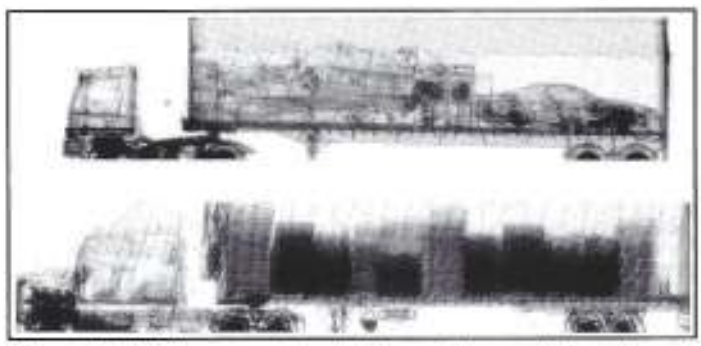
It is capable of full target (bumper-to-bumper) scans of objects up to 21.3 m long. The unit consists of two 27.4 m long tracks, a gamma ray source, and a 6.4 m high detector tower.

Image analysis is available to the operator through the integrated image processing software tools supplied with the system. Image storage, transfer, and recall capabilities are included.

Specifications
Spatial resolution: 12.7 mm nominal resolution on the centre of the target being imaged
Penetration: 102 mm of steel with 1.0 Ci Cs^{137} gamma source; 158.75 mm with 0.75 Ci Co^{60} source
Scan rate: approx 0.3 m/s
Oblique angle inspection: 0 to 20° off-axis imaging
Operating temperature: –30 to +50°C
Power: 240/120 V AC, split-phase (4-wire), 50/60 Hz, 30A
Vehicle capacity: scans objects up to 9.1 m wide × 21.3 m long × 3.96 m high in a single scan
Wind speed: can operate in wind conditions up to 40 mph

Status
In production and in service.

Relocatable VACIS can non-intrusively inspect large vehicles and cargo containers (SAIC) 0122518



Relocatable VACIS can non-intrusively inspect large vehicles and cargo containers (SAIC) 0546822

Contractor
Science Applications International Corporation (SAIC).

RTR-4® portable digital X-ray imaging systems

Development
The RTR-4 system was designed to provide rapid image acquisition and image enhancement and measurement tools for small object or package inspection. RTR-4® systems are rugged, portable, fully digital X-ray imaging systems used by law enforcement, EOD teams, first responders and postal inspection personnel to investigate suspicious packages for the presence of narcotics or explosive devices, and by EOD operators to evaluate UXO and determine fuzing configurations. They can also be used by corporate security staff for mailroom inspection and point-of-entry examination of personal belongings, by customs personnel for investigating packages, vehicle panels and tyres for hidden contraband, and quality assurance inspectors for manufacture process control.

Description
The RTR-4 system is easy to assemble and operate, and requires minimal training and maintenance. More than 1,500 RTR-4 systems have been ordered and delivered to date and are used for a variety of inspection applications throughout the world.

The instrument consists of a control unit, X-ray imager, X-ray source and connecting cables and accessories. A wireless communications option is also available that eliminates cabling to simplify set up and expand operating scenarios.

The entire system is stored in a robust, high-impact plastic transport case with foam inserts. The control unit, a Toughbook computer, operates the powerful RTR-4 software and was designed to withstand harsh conditions. The cable connecting the imager to the control unit is 50 m long, allowing the operator to be a safe distance away from the inspection area. Optional extension cables can also be used. The system has been tested with more than 100 m of cable between the control unit and imager without noticeable degradation of image resolution.

The RTR-4 is designed primarily for use with a Golden Engineering XR200 X-ray source. This pulsed, portable source produces extremely short bursts of X-rays capable of penetrating several inches of most materials. The source generates extremely low radiation dose (integrated exposure) levels outside the direct source beam, allowing operation in confined spaces. Other X-ray sources can also be used.

For enhanced durability the system is supplied with a full magnesium alloy case with carry handle; moisture- and dust-resistant LCD, keyboard and touchpad; sealed port and connector covers; shock mounted and removable hard disk drive in stainless steel case. The case has a vibration and drop-shock resistant design and rugged hinges.

A large area imager is also now available.

RTR-4® portable, digital X-ray imaging system (SAIC) 0569502

Specifications

Control unit
- display: 15" (381 mm) LCD displaying 24-bit true colour at 1024 × 768 XGA resolution
- disk drive/storage capacity: 256 MB SDRAM standard, expandable to 512 MB (PC133 memory required); 30 GB HDD; 1.44 MB FDD (also combo drive DVD-ROM/CD-RW)
- dimensions: 60 × 240 × 300 mm
- weight: 4 kg
- power: Lithium ion battery pack (11.1 V, 5.4 Ah)
- battery operation: up to 4.0 hours (with first battery), up to 10 hours (with second battery)

XR200 source
- source: 150 kVp max energy, 3.3 µSv output dose at 1 m, radiation behind beam under 1.0 µSv/pulse
- dimensions: 110 × 190 × 320 mm
- weight: 5.5 kg with battery

Performance: able to distinguish 0.2 mm wire behind 3 mm steel
Total penetration (using XR200 source): >15 mm steel
Total deployed weight: 34 kg
Operational humidity: up to 95% humidity at 35°C

Status

In production. In service with units of the US FBI Bomb Data Center, as well as other bomb squads and EOD teams worldwide.

Contractor

Science Applications International Corporation (SAIC).

RTR-4N portable X-ray imaging system

Development

The RTR-4N is compact digital X-ray imaging system based on the RTR-4® (see separate entry) configured with a standard notebook computer.

Description

Small, lightweight and durable, the RTR-4N provides EOD teams with the ability to quickly and efficiently search areas that are too difficult or time-consuming to search by hand. The system can distinguish 40 AWG wire (0.08 mm) in air and 34 AWG (0.16 mm) wire behind (1/8) inch (3 mm) steel plate. Digital transmission gives no image degradation and the system has a viewing resolution of more than 1.3 line-pairs per mm for sharper images. The RTR-4N operates without film; images are instantly displayed and can by saved in an industry-standard format.

RTR-4N portable X-ray imaging system (SAIC) 0122519

Specifications

Portable notebook control unit
- display: 15 in (38.1 cm) thin film transistor LCD displaying 24-bit true colour at 1,024 × 768 XGA resolution
- disk drive/storage capacity internal: hard disk 30 GB or more; internal DVD/CD-RW drive; memory 256 MB expandable to 1 GB
- processor Pentium: IV 2 GHz or higher
- battery: Lithium-Ion Smart battery
- dimensions: 330 × 270 × 50 mm
- weight: 3.45 kg

X-ray imager
- dimensions: 300 × 358 × 145 mm
- active area: 200 × 250 mm

XR200 source
- source: 150 kVp max energy, 3.3 µSv output dose at 1 m, radiation behind beam under 1.0 µSv/pulse at 6 cm
- dimensions: 110 × 190 × 320 mm
- weight: 5.5 kg with battery

Operational humidity: up to 95% humidity at 35°C
Operational temperature
- control unit: +10 to +35°C
- imager: –29 to +52°C

Storage temperature
- control unit: –10 to +60°C
- imager: –40 to +60°C

Total weight: 34 kg

Status

No longer in production.

Contractor

Science Applications International Corporation (SAIC).

For details of the latest updates to *Jane's Explosive Ordnance Disposal* online and to discover the additional information available exclusively to online subscribers please visit **jeod.janes.com**

SmartCheck

Development
The SmartCheck system was designed to screen threats hidden under a person's clothing. It is a safe and effective method to detect explosives, weapons, drugs and other contraband. Applications include: airports, high-threat facilities, military bases, prisons as well as commercial facilities. The system was launched at ASIS International in 1995.

Description
SmartCheck's Z® Backscatter X-ray technology makes it possible to detect all types of threats, both metallic and non-metallic objects on a person's body, including plastic and metal weapons (for example: guns, knives, box cutters, composite weapons), explosives, drugs and other contraband. The system provides operators with easy to interpret images that display the shape, size and location of potential threats or contraband hidden on a person, allowing operators to quickly and reliably identify threats. The system uses unique algorithms to display only an outline of the scanned individual and the outline of any potential threat on the person.

Backscatter X-ray technology is safe for both operators and scanned individuals, with the radiation dose from a single scan at less than 10 microrem (0.1 microsieverts) per scan which is equivalent to two minutes of airplane flight at altitude. It meets the manufacturer's requirements of the American National Standards Institute (ANSI) standard N43.17, which is the standard that the Center for Devices and Radiological Health (CDRH) references for systems such as SmartCheck.

Specifications
Length: 163 cm
Width: 117 cm
Height: 229 cm
Transport height: 201 cm
Transport width: 87 cm
Weight: 680 kg
Scan time: 8 s/scan
Mobility: equipped with swivel castors and levelling feet

Status
In production. In 2007, the US TSA selected SmartCheck as part of a pilot programme for several US airports. In 2008, the system was selected for pilot trials at Sydney International Airport, Australia.

Contractor
American Science and Engineering Inc.

The eXaminer 3DX 6000

Description
The eXaminer 3DX 6000 explosive detection system uses automatic computer tomography (CT) scanning to provide a three dimensional analysis of luggage. The system operator is provided with automated visual displays to enable them to identify threat materials and alarm objects. A bag and its contents can be viewed from 2-D projected viewing angles, in a rotating 3-D view, or as individual CT slices.

The dual-energy X-ray feature will accurately discriminate density, atomic number, shape and texture of explosives, thereby maximising detection probability while reducing false alarm rates. A continuously rotating gantry, on which the X-ray source and opposing X-ray detector array are mounted, produces three-dimensional data that is analysed by computer for the presence of explosives.

The inspection is made as bags move on conveyors from airport ticket counters (or curbside) to aircraft loading stations. Bags are processed through the eXaminer 3DX 6000 at an average rate of 675 bags per hour (5.5 seconds per bag), allowing screening of passenger baggage for a Boeing 747 aircraft in 40 minutes or less.

Specifications
Tunnel opening: 800 × 630 mm
Conveyor belt height: 1 m
Conveyor speed: 150 mm/s
Conveyor capacity: 136 kg
X-ray sensor: 6048 detectors Helical-cone-beam, multislice computed tomography
Weight: approx. 3050 kg
Operating temperature: +10 to +35°C

Status
In production and in service in US airports.

The eXaminer 3DX 6000 uses computer tomography scanning technology (L-3 Communications) 0573706

Contractor
L-3 Communications Security and Detection Systems (formerly Lockheed Martin Specialty Components).

Under Vehicle Inspection systems (UVI)

Development
The Under Vehicle Inspection System (UVI) is an effective tool to prevent the entry or exit of contraband material from secure facilities. The UVI aids security personnel in conducting a quick and thorough inspection of all types of vehicles.

Applications include: EOD, bomb detection, contraband and drug detection at military bases, government buildings, oil refineries, under ground garages, nuclear power plants, border check points, embassies, prisons, courthouses, banks/mints, airports/ports and munitions plants.

Description
The Under-Vehicle Inspection (UVI) unit is available as a fixed site or mobile system. The unit features a water proof camera which provides video of the underside of vehicles at remote locations, it complies to MIL-STD-810E standards. Within seconds, the underside can be scanned for bombs, attached packages and other devices. The video images of the undercarriage can instantly be replayed and reviewed with the built-in Jog Shuttle VCR.

The system's controller is rack mounted in a shock-resistant aluminium carry/transport case. Also installed is a rack mount monitor (available in black and white or colour).

Under-vehicle video inspection unit 0004712

The system is fully weatherproof. When positioned at a controlled entry point, all vehicle traffic can be directed over the inspection ramp. The video ramp includes four wide-angle cameras and three illuminating modules for low-light situations. The optional 'Airclean' system consists of four pop-up valves placed next to each camera lens to blow away standing water or debris. The command centre includes controls for quad splitter, monitor, cameras, lighting modules and a high-resolution monitor producing a high-resolution video image. The power source is 110 or 220 V AC and the whole system is easily transported in a medium-sized car. The unit can be set up and become fully operational within 20 minutes.

Specifications

Max vehicle weight
camera assembly: approx. 13,600 kg
rubber bumpers: approx. 22,700 kg

Ramp length: 2.56 m
Ramp height: 64 mm
Power supply: 120 or 220 V AC
Video: NTSC or PAL
Operating temperature
controller: –18 to +38°C
camera assembly: –40 to +71°C
Cable: military grade, stainless steel braided

Status

In service in the United States.

Contractor

LEA, Law Enforcement Associates Inc.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Austria

EUROLITE® Explosive Ordnance Disposal (EOD) NBC overgarment

Type
Individual protection – Body protection

Description
This is a two-piece suit intended for first responders conducting EOD in toxic environments or when dealing with a suspected Chemical Biological Radiological Nuclear (CBRN) device. The suit is intended to be worn over ballistic-protective suits. It is constructed of 150 g/m² EUROLITE® barrier film and features integrated reinforced overshoes and hood with a large window. The suit has space for breathing apparatus and meets ASTM and NFPA standards for protection against a range of chem-bio threats and TICs. The suit has elasticated closures at the tunic waist and at the sleeve-ends, adjustable braces/suspenders and is donned from the rear. It is vacuum packed for low-volume storage and can be incinerated with no toxic residue. The standard colour is olive green with others available on request.

Status
Available. In service with Austrian armed forces.

Contractor
Goetzloff GmbH.

EUROLITE® EOD NBC overgarment
(Goetzloff GmbH)
1067926

Canada

Alternate Power Supply (APS)

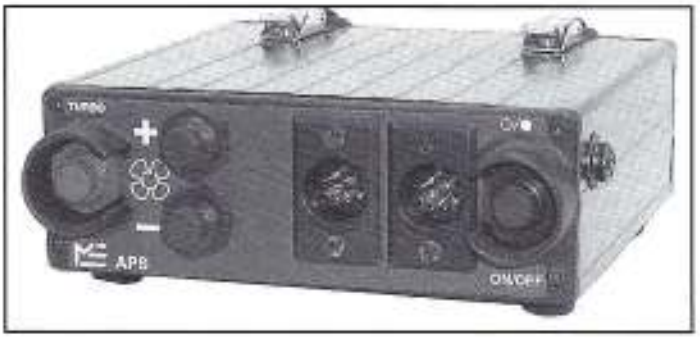
Description
The Alternate Power Supply provides a source of power for all Med-Eng helmet accessories as an alternative to the Intelligent Power Supply (see separate entry).

The unit operates on either alkaline or rechargeable NiCd batteries. It features basic on/off functionality for up to 8 hrs of mission duration time.

Specifications
Available upon request.

Status
In production and in service.

Contractor
Med-Eng Systems Inc.



Alternate Power Supply
(Med-Eng Systems)
1174912

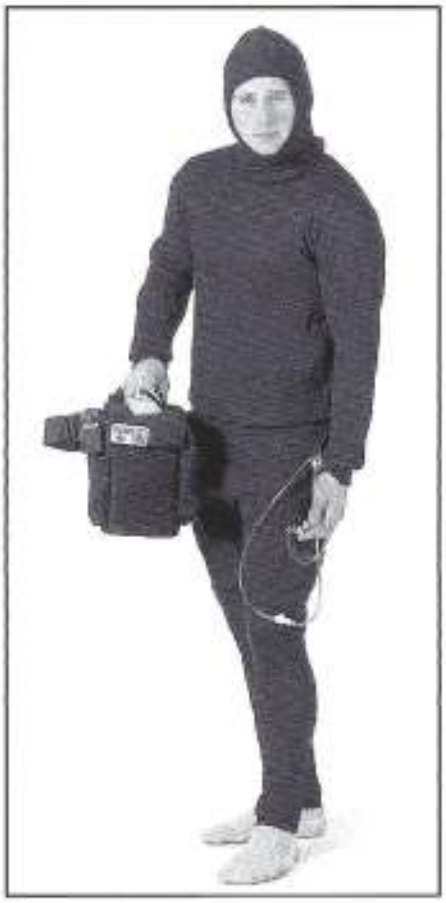
BCS-3 and BCS-4 body cooling systems

Description
The BCS-3 and BCS-4 are personal cooling systems designed to help regulate the operator's core body temperature during operations. The system extends work duration and reduces the risks of heat-stress symptoms such as fatigue and loss of concentration. The improved BCS-4 is recommended by the manufacturer for use with the EOD-9, EOD-8, SRS-5 and EOD-7B helmet and suit ensembles (see separate entries).

The BCS-3/BCS-4 systems include a Liquid Circulating Garment (LCG), either a 3-piece LCG suit (hood, long-sleeve shirt, and trousers), or an LCG vest and hood. The LCG is a lightweight and flexible garment that is worn underneath the protective ensemble, over a T-Shirt or directly against the skin. Woven into the Kermel fabric is a series of tubes, through which cold water is circulated over the body. The tubing connects to a cooling unit (a pump and water bottle) contained in a heavy-duty nylon insulated pouch. The pouch is strapped to the outside of the operator's leg. The cooling unit provides a flow of cool water for heat removal.

The BCS-3 has alkaline and rechargeable battery options and includes a variable pump that requires priming and which is user-adjustable, having a variable cooling rate. The BCS-4 is available only in the rechargeable battery option. Other modifications to the BCS-4 include a reduction in overall weight and the elimination of the priming requirement. Both systems are available in a variety of sizes.

BCS-3 worn with the SRS-5 ensemble showing the additional auxiliary cooling unit
(Med-Eng Systems Inc)
0074029



BCS-3 body cooling system
(Med-Eng Systems Inc)
0632030

BCS-4 body cooling system LCG vest and LCG suit
(Med-Eng Systems Inc.)
1311316

Status
In production.

Contractor
Med-Eng Systems Inc.

Chemical Protective Undergarment (CPU)

Development
The Chemical Protective Undergarment (CPU) is designed to provide vapour protection against a range of potentially hazardous chemical and biological agents. Originally designed in 1991 for the United States Special Forces, LANX I is the only fabric approved for chemical protective undergarments (CPU) by the US Military based on the Joint Services Light Integrated Suit Technology (JSLIST) test program. The undergarments are suitable for applications such as law enforcement, fire departments, first responders, government contractors, hazardous material response agencies and special security units.

Description
It must be worn under a blast protective ensemble, such as the SRS-5 suit or EOD-9 suit with the SRS-5 helmet and VBC-250 visor (see separate entries). It is not intended for use as an overgarment in conventional hazardous material clean-up operations.

The CPU is durable and uses polymerically encapsulated carbon as its base absorption technology, providing uniform carbon distribution for optimum user protection.

The standard CPU ensemble includes a hood, long sleeve jacket, trousers and boot liners. Gloves are available as optional accessories. CPU components can be purchased separately.

Although the CPU is air permeable to allow evaporative cooling, use of the BCS-3/BCS-4 body cooling system (see separate entry) is recommended by Med-Eng Systems for increased heat stress reduction.

The CPU is made from stretchable fabric to ensure a snug fit and is available in grey. The jacket and trousers are available in small to large sizes, the boot liners are small to extra large, the hood is one-size and the optional gloves are small to large.

The CPU must be worn with protective gloves and a self-contained breathing apparatus. The CPU is compliant to military specification MIL-U-44435.

Specifications
Basis weight: 475–576 g/m²
CCL4 performance: min 1.8 mg/cm²
Thickness: 2.6–3.0 mm
Air permeability: 10–13 cc s^{-1}/cm^2
Bursting strength: 240 N

The CPU can add chem/bio protection to EOD suits
(Med-Eng Systems Inc)
0098418

Status
In production. Export restrictions relate to this product.

Contractor
LANX Fabric Systems. Agent: Med-Eng Systems Inc.

EOD-7B explosive ordnance disposal suit and helmet

Description
The EOD-7B explosive ordnance disposal suit and helmet ensemble was the forerunner of the EOD-8 (see separate entry). Although technologically the EOD-7B has been surpassed, it is still used widely across the EOD community.

The suit was designed to provide balanced protection against overpressure, fragmentation and impact, while a flame-resistant outer shell also offers protection against heat and flame. It also features a quick-release mechanism in case of emergency extraction.

The helmet offers full face, neck and head protection against the four major blast threats while retaining a wide field of vision. It includes integrated ventilation, communications speakers, microphone and ambient sound amplification.

For improved protection against fragmentation, the EOD-7B suit and helmet ensemble can be equipped with additional options including a collar insert, chest plate, groin plate and a visor cover.

Specifications
Available upon request.

Status
No longer in production.

Contractor
Med-Eng Systems Inc.

EOD-7B
(Med-Eng Systems Inc)
0098240

EOD-8 Explosive Ordnance Disposal Suit and Helmet

Description
The EOD-8 explosive ordnance disposal suit and helmet ensemble has been designed to offer the highest level of protection against overpressure, fragmentation, impact and heat/flame. It is designed to provide the operator with an optimal balance of protection and comfort, taking advantage of the flexible design of the SRS-5 lightweight explosive protection system (see separate entry) to minimise operator fatigue while also offering the enhanced protective technologies of the older EOD-7B (see separate entry).

Features of the suit include an integrated groin protector, a quick-release mechanism in case of emergency extraction, leg extenders for improved fit and comfort, a retractable groin plate for easier kneeling and colour-coded Velcro® to ensure proper dressing.

The EOD-8 helmet is a full-face helmet which features a floating visor system. It offers balanced protection against the four major blast threats and, according to the manufacturer, includes a number of improvements over earlier generation helmets: increased protection against blast-induced head acceleration; a re-designed retention system for improved balance and greater stability; integrated speakers and microphone; and an improved Environmental Awareness System (EAS). Its electronics meet MIL-STD-810D 501.2 (High Temperature), MIL-STD-810D 502.2 (Low Temperature) and MIL-STD-810D 514.3 (Vibration) standards.

Specifications
Available upon request.

Status
In production and in service.

Contractor
Med-Eng Systems Inc.

EOD-8 suit
(Med-Eng Systems Inc)
0532031

EOD Hand Protection System

Description
The EOD Hand Protection System is designed to provide the wearer with protection against flash heat, incendiary agents and fragments, while allowing a high degree of manual dexterity. The system consists of Nomex™/Kevlar™ fire-retardant gloves and ballistic hand covers.

Velcro™ attachment patches run along the back of each glove and the inside of each ballistic hand protector, facilitating secure attachment and allowing lengthwise adjustment for the position of the hand protectors.

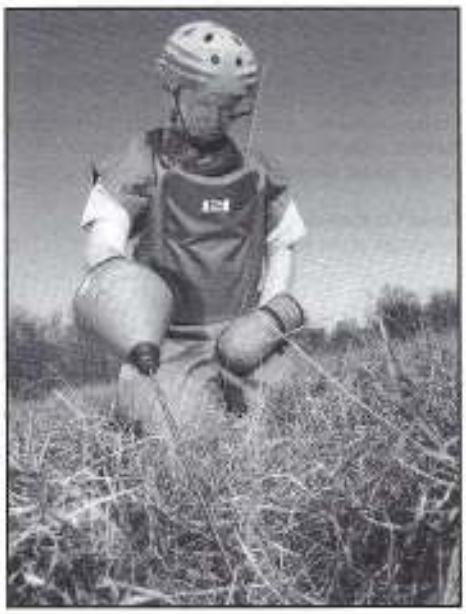
For operations involving a device known to contain, or suspected to contain, chemical or biological agents, appropriate and approved gloves must be used. The EOD Hand Protection System gloves are not intended for such operations. However, the ballistic hand protectors could be used in conjunction with appropriate and approved gloves. The gloves are not intended to protect the user if hand-carrying a suspect package.

Specifications
Available upon request.

Status
In production and in service.

Contractor
Med-Eng Systems Inc.

The EOD Hand Protection System provides protection against fragmentation and fire (Med-Eng Systems Inc) 0098411



EOD Hand Protection System in use (Med-Eng Systems Inc) 1311318

EOD/IEDD suit ballistic add-on armour

Description
In order to bring the level of protection offered by their EOD-7B suit up to that of the EOD-8 (see separate entries), Med-Eng supplied ballistic add-on armour. This was intended for use in EOD or Improvised Explosive Device Disposal (IEDD) situations with a high fragment risk. The full set comprised visor cover, collar insert, chest plate and groin plate. Users of the EOD-8 suit only required the visor cover, which was available separately.

The armour inserts were made from steel: the visor cover featured a unique asterisk-type viewing 'slit' configuration and was backed with energy-absorbing foam for increased fragment protection and to minimise impact transfer.

Specifications
Available upon request.

Status
No longer in production.

Contractor
Med-Eng Systems Inc.

Ballistic add-on armour can increase the fragment protection of the EOD-7B suit (Med-Eng Systems Inc) 0098425

Intelligent Power Supply

Description
The Intelligent Power Supply can power the electronics of the EOD-9, EOD-8, EOD-7B and SRS-6 helmets.

The unit is controlled by a microprocessor and operates on either alkaline or Ni/Cd batteries. The battery pack comes with an on/off switch, as well as ventilation system flow rate adjustment, ventilation turbo-boost mode, a battery level charge indicator on the front panel and built-in charge/recharge capability.

Specifications
Available upon request.

Status
In production and in service.

Contractor
Med-Eng Systems Inc.

The Intelligent Power Supply provides power to the Med-Eng range of helmets (Med-Eng) 0098408

Med-Eng Advanced Clearance Ensemble (ACE)

Description
The Advanced Clearance Ensemble (ACE) is designed to provide scalable personal protective equipment for soldiers performing a range of operational tasks during peacetime or conflict, including mine, UXO and booby trap clearance. The suit comprises lightweight modular components that are easily donned and removed without assistance and that provide fragmentation and ballistic protection. The ACE vest forms the basis of the ensemble and trousers, sleeves and either blast or ballistic plates can be added as required.

Specifications
Available upon request.

Status
In production and in service.

Contractor
Med-Eng Systems Inc.

The Advanced Clearance Ensemble provides protection for a range of operational tasks
(Med-Eng Systems Inc)
1041291

Med-Eng EOD-9 Explosive Disposal Suit and Helmet

Description
The EOD-9 suit and helmet ensemble provides a high degree of protection, as well as operational flexibility, for EOD/IEDD in CBRNE missions and can be configured in the field by an EOD or IEDD technician based on their threat assessment.

According to the manufacturer, the EOD-9 suit builds upon the protective strength of the EOD-8 suit while maintaining the physical flexibility of the SRS-5 suit. It includes a jacket, integrated groin protector and trousers (including boot covers) and also features an integrated carrying pouch to hold the optional Med-Eng BaquaPak, a hands-free hydration system from which the EOD operator can draw water through a clip-on mouthpiece. The BaquaPak can contain up to 2 litres (3.5 pints) of liquid within the insulated pouch and is easily refilled.

The EOD-9 Helmet can use two interchangeable visors and includes a wrist-mounted remote control module for better control of helmet functions.

The EOD-9 ensemble is designed to provide protection against overpressure, fragmentation, impact and heat/flame. It integrates with a Chemical Protective Undergarment (CPU) to provide a level of chemical-biological blast protection and Med-Eng personal cooling system to mitigate the risk of heat stress.

Specifications
Details are available on request.

Status
In production and in service with the US Army.

Contractor
Med-Eng Systems Inc.

EOD-9 explosive disposal suit and helmet
(Med-Eng)
1174923

'Next-to-Skin' chemical protective garment

Description
The 'Next-to-Skin' garment is reported to provide protection against chemical agent vapour with minimal thermal load on the user. It is a close-fitting, breathable garment designed to be worn under bomb suits, combat clothing, uniforms or civilian clothing. It is not intended to provide protection against liquid contamination and therefore should be worn with the appropriate protective outfit for those situations where liquid contamination may be present. The garment comprises a hood, long-sleeved jacket and trousers. The close-fitting design reduces bunching and abrasion when worn with belts, harnesses, backpacks and so on. It must be worn with appropriate protective gloves, boots and gas mask.

The garment is made from a charcoal knit laminated with polyester knits on both sides and is available in a range of sizes.

The 'Next-to-Skin' garment was originally developed by Vanguard Response Systems Inc who merged with PW Allen to form Allen-Vanguard.

Status
In production.

Contractor
Allen-Vanguard.

The 'Next-to-Skin' garment can be worn under a bomb suit.
(Allen-Vanguard)
0573668

Series 5000 shield system

Description
The Series 5000 shields are designed to provide increased mobile protection against overpressure and fragmentation during EOD/Improvised Explosive Device Disposal (IEDD) or forced entry operations. The shields are available in three configurations: the TAC-5000, designed for tactical operations; the EDU-5000, for explosive disposal; and the EDU-TAC-5000, which can be used for both these operational requirements.

The TAC-5000 is equipped with soft ballistic vertical edge shrouds for close fitting against vertical, rough-surface walls, such as brick or breeze block.

When used with an appropriate bomb disposal suit and helmet ensemble, the EDU-5000 is designed to provide enhanced personal protection during explosive disposal operations, protecting against overpressure, fragmentation, impact and heat. The EDU-5000 has adjustable, pull-out legs which allow it to be freestanding.

The series 5000 shields are constructed of Kevlar™ and include a Lexan™ ballistic visor. The shields have interchangeable left and right handles, a strap-support system to reduce operator fatigue and ethafoam pads to protect against body impact with the shield.

Specifications
Visor dimensions: 110 × 195 mm
Shield dimensions: 1.3 × 0.76 m
Approximate weight (basic shield without shrouds, legs and cover): 14 kg
Colour: black

Status
No longer in production.

Contractor
Med-Eng Systems Inc.

Series 5000 shield system – back view
(Med-Eng Systems)
0125384

SRS-5 suit and helmet

Description
As well as providing a high degree of protection against overpressure, fragmentation, impact and heat/flame during demining, the patented SRS-5 suit and helmet ensemble is designed to provide chemical and biological protection during low-level EOD-IEDD operations involving agent contaminants. In such situations, the ensemble should be worn in conjunction with a Chemical Protective Undergarment (CPU), an extra-large SRS-5 helmet with VBC-250, a SCBA system and appropriate chemical-biological protective boots and gloves.

The SRS-5 suit's light weight and flexibility make it a suitable ensemble for operators undertaking search and reconnaissance missions, 'number two' personnel and dog handlers. It includes a quick-release mechanism for emergency extraction, Velcro leg straps to adjust the fit and a retractable groin plate for easier kneeling.

The suit and helmet combination allows a wide field of view while providing full face, neck and head protection. The SRS-5 helmet has three visor options: VB-250, for typical search operations and which has a V-50 protection rating of 250 m/s; VBC-250, for integration with SCBA respirator; and VBE-580, for enhanced fragment protection and which has a V-50 protection rating of 580 m/s. It can also be equipped with communications capability to enable the wearer to hear ambient noise and to connect to a radio and a mine detector.

Status
In production and in service.

Contractor
Med-Eng Systems Inc.

SRS-5 suit and helmet ensemble
(Med-Eng Systems Inc)
1174931

Czech Republic

Zeman AM mine resistant boots

Description
Zeman's mine resistant boots are designed to provide leg protection against anti-personnel mines containing up to 70 g of high explosives (TNT) equal to 50 g charge of of Semtex and have been developed by Zeman in co-operation with Aall Chladek explosives consultants (see separate entry). The boots have been tested at the Department of Theory and Technology of Explosives, University of Pardubice.

The boots are intended to be worn as a normal combat boot. Protection is provided by flexible multi-layer armour in the sole and blast-resistant inserts in the toecap and heal seat. The boots do not contain any metallic components. Cambrella or Sympatex® breathable waterproof linings are available as an option.

Specifications
Upper material: 2 mm hydrophobic grain leather
Colour: black
Boot height: 30 cm
Weight: 2.98 kg
Sizes: 37–48

Status
In service.

Contractor
Zeman Technogroup Ltd.

Finland

Mine Clearance/Lightweight EOD Suit

Description
This modular suit is designed to be used in search and clearance operations for mines, unexploded ammunition and other explosives, providing protection against fragmentation, overpressure and heat.

The suit is designed to achieve a balance between protection, lightweight and flexibility. It consists of a half-overall, a pair of sleeves and a specially fortified one-piece vest. Insert plates give added protection to the chest and groin areas. The vest incorporates a turnable groin protector, a pouch and fastenings for equipment. The collar is sufficiently wide to house the visor of a helmet to prevent it from being forced open by a pressure wave. It is available in one size and the fit is adjusted by means of straps, buckles and Velcro fastenings. The ballistic panels are detachable to enable the outer cover to be washed.

The basic protection level has been upgraded in parts of the suit to provide additional protection to the most vulnerable parts of the body. For increased comfort the overall and sleeves are open at the rear for ventilation.

Optional accessories include a balanced composite helmet with polycarbonate visor and a carrying bag.

At the beginning of 2008 Ballistic Protection Burgmann Oy changed its name to Verseidag Ballistic Protection Oy.

Specifications
Protection levels (V50 STANAG 2920)
general protection: 450 m/s
chest area with insert plate: 1,200 m/s
groin area with insert plate: 1,200 m/s
collar: 600 m/s
front thigh: 600 m/s
front knee: 800 m/s
front shin: 600 m/s
Total weight: 15 kg
Colour: olive green, dark blue, camouflage (to order)

Status
In production. In service with the Finnish Army; Swiss Army; UN peacekeeping forces in KFOR and ISAF operations; and UN-supported mine-clearing operations in Angola, Ethiopia and Mozambique.

Contractor
Verseidag Ballistic Protection Oy.

The Mine Clearance/Lightweight EOD suit protects the torso, neck area, arms, abdomen, groin area and legs (Verseidag Ballistic Protection Oy)
0529577

France

Anonymate Mine Boot

Description
The Anonymate mine boot is designed to spread the blast of anti-personnel mines, reducing their impact by up to 80 per cent while allowing sufficient mobility to enable the wearer to walk, or run, on all types of terrain. The rigid sole profile permits natural walking while the internal sole includes a damping material to attenuate blast. The boot uppers are formed from a composite material: the external leg provides protection while the internal leg allows for movement of the foot and ankle.

The boot received an initial evaluation in 2003 and final evaluation took place in 2005.

Status
In production and available, mainly for armies, in several countries worldwide.

Contractor
Anonymate.

Germany

Blast Protected Combat Boot 'BCB-1'

Description
Force Ware's blast protected combat boot 'BCB-1' is designed to be used as standard military issue. The boot has been tested at Cranfield University Ordnance Test and Evaluation Centre in the UK against certain common types of anti-personnel landmine of different explosive charge sizes.

The protection system in the BCB-1 is incorporated in the upper as well as the sole of the boot. The main protection system in the sole makes the boot flexible and manoeuvrable. With the added protection system the BCB-1 weighs only 950 g. This makes the boot suitable for prolonged use without compromising performance by the user.

Specifications
Upper material: Leather outer shell – water resistant
Thickness: 1.4 to 1.6 mm
Elongation at break: 3.3%
Weight: approx 950 g per boot (size 42)
Sizes: 39–46
Lacing system: comprises a set of eyelets, loop-hole hooks and rivets allowing full adjustability and quick release

Status
In production.

Contractor
Force Ware GmbH.

Black Leather Boot (Force Ware GmbH) 1168396

Leather Sand Coloured Boot (Force Ware GmbH) 1168397

BPS-1 fragment protection suit

Description
The BPS-1 is a heavy bomb protection suit for EOD personnel. Comprising jacket, trousers with chest flap, back apron, helmet with visor and a control pad, it is designed to provide protection against fragments, detonation pressure, heat and acidic burns.

The suit is also supplied with a carrying bag, while internal communication equipment and air conditioning/ventilation options are also available. The suit comes in one size but the fit can be altered by use of adjustable straps and V-shaped Velcro® fasteners. Pockets are provided to enable items such as tools to be carried.

The outer fabric can be as specified by the customer, for example Nomex® flame-retardant or antistatic fabric. Ballistic protection is provided by multiple layers of aramid fabric, with metallic plates giving additional frontal and collar protection.

The helmet comprises a 3 mm high-grade titanium shell with layered aramid inner and can be adjusted to fit a range of head sizes.

Specifications
Weight (suit): approx 23 kg
Weight (helmet): 2 kg

Status
No longer in production.

Contractor
Force Ware GmbH.

EOD Squad Suit M-98

Description
Force Ware's M-98 is designed for the all-round protection of bomb disposal experts and consists of trousers, vest, sleeves, belt set, helmet and a carry bag. Front pockets allow for the storage of EOD tools and the use of Velcro fasteners allow the suit to be quickly put on or removed.

Specifications
Weight of suit: 21 kg
Protection level (V50): Sleeves and trousers: 400 m/s Vest: 500 m/s

Status
Available.

Contractor
Force Ware GmbH.

Israel

RAV 501 EOD squad suit

Description
The RAV 501 EOD squad suit is designed to protect bomb disposal operators from all types of high-velocity fragments, overpressure and intense heat in case of a close-proximity explosive detonation. This Israel Defence Force standard, light, two-piece suit offers protection without restricting movement for the delicate work performed by the bomb disposal operative.

Status
In production and in service.

Contractor
Rabintex Industries Limited.

RAV 501 EOD suit
0065561

Singapore

BfR V-50 combat boot

Description
This Blast and Fragment Resistant (BfR) combat boot is the world's first standard issue military combat boot that provides soldiers with a measure of protection against anti-personnel landmines. The BfR V-50 combat boot is designed to mitigate soft tissue and skeletal damage to the feet by deflecting blast from AP mines.

It has a unique protective sole. Developed with patented technologies, the sole has a woven fabric bonded together with specially constructed sole and heel plates and heel plug.

Cross section of the BfR V-50 combat boot (BfR SG Pte Ltd) 1197619

BfR V-50 combat boot (V50138 model) (BfR SG Pte Ltd) 1197621

The protection features are also incorporated in the upper part of the boot. It weighs about 950 g for an average size boot.

Status
Available.

Contractor
BfR SG Pte Limited.

South Africa

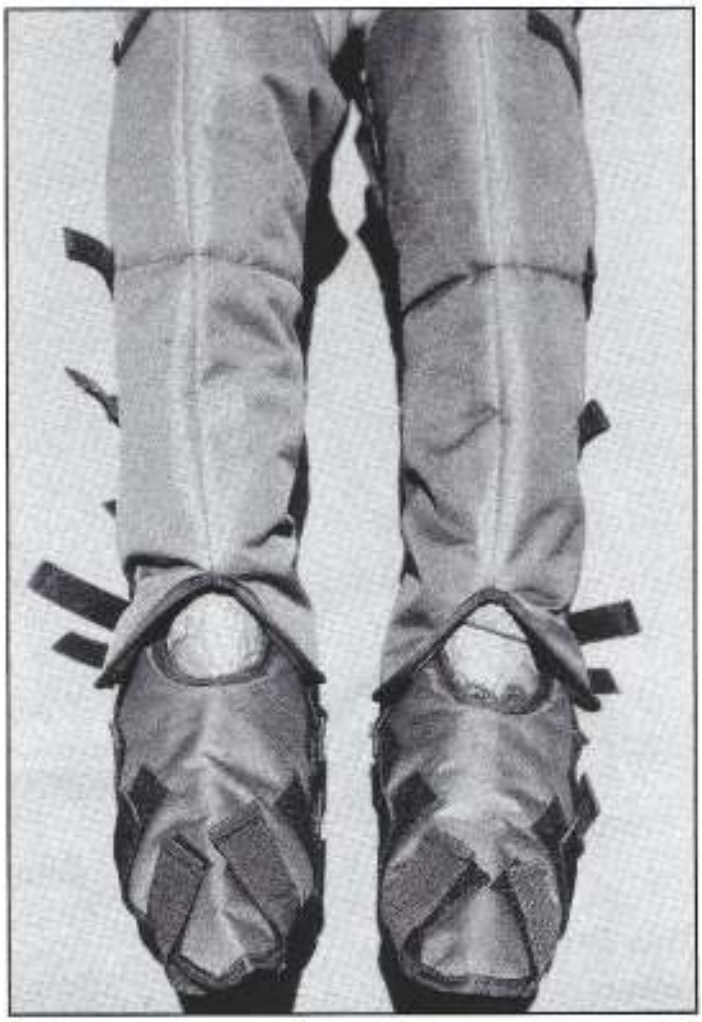
Armadillo Demining Suit

Description
The Armadillo is an anatomically designed demining suit made from ultra lightweight material.

Anti-Personnel (AP) landmines frequently cause severe injuries to the groin, lower abdomen, genitals and buttocks – areas where blood loss is notoriously difficult to stop in the field and many victims die from these injuries before reaching a hospital. In addition to prolonged psychological trauma, survivors are subjected to repeated surgical procedures to treat these wounds.

The Armadillo Demining Suit protects these areas and thereby increases chances of survival by limiting the severity of shrapnel injuries. It consists

Main body suit 0021498



Leggings and overshoes 0021498

of the following pieces: main body suit (weight 1.4 kg) that protects the neck, chest, abdomen, groin, buttocks; trousers (weight 1 kg) that provide additional groin protection, and protect the inside and front of the thighs; leggings (weight 0.5 kg each) that protect the calf (whole circumference) and extend to above the knee; and overshoes (weight 0.2 kg each) that protect the foot (excluding sole). Total combined weight is 4 kg.

The suit is manufactured from non-woven, ultra lightweight polyethylene fibre. The manufacturer claims that it can be worn routinely by deminers or other personnel working in mined areas (security, construction and so on), with maximum comfort under all weather conditions.

Status
No longer in production.

Contractor
Tactical Medical Developments CC.

Trousers
0021497

United Kingdom

Bollé protective eyewear

Description
As specialist eyewear manufacturers Bollé can offer a range of products specifically designed for military, tactical and industrial applications.

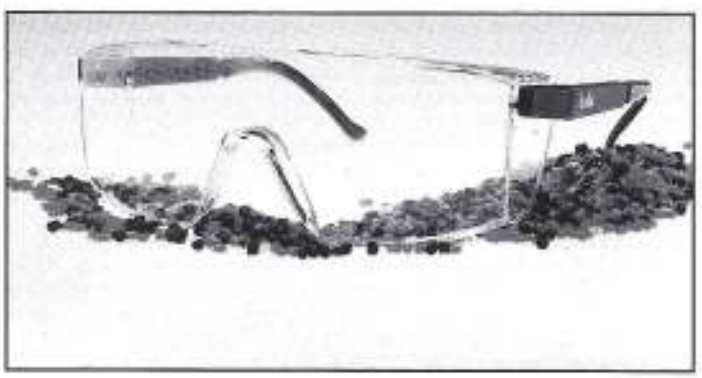
The Bollé Ballistic Eyeshield (Frisco) has a 2.4 mm dual coated fog and scratch resistant polycarbonate wrap around lens and side arms that are adjustable for length and angle. Optional non-slip silicone nose bridge and retaining headstraps are available and the eyeshield offers good all round protection and field of vision. The eyeshield is approved to BS EN 1661F (impact of 6 mm steel ball projectile at 45 m/s). The Ballistic Eyeshield is issued to local field staff by Mines Advisory Group and while it is accepted that sufficient protection would not be afforded in the event of an unexploded ordnance accident, it is considered adequate for use when detonator crimping.

Where a higher level of impact protection is required the Bollé Shield Goggle is available. This was specifically designed and used by coalition special forces and mine clearance units during operation Desert Storm. The PVC frame, with a foam padded nose bridge, is fitted with a 6 mm polycarbonate lens, tested to STANAG 2920 V50 at 245 m/s.

Status
No longer in production.

Contractor
Bollé (UK) Limited.

Bollé Shield Goggle (Bollé) 0074411



Bollé Ballistic Eyeshield
(Bollé)
0074412

EOD vests

Description
International Intelligence Limited offers a range of body armour designed to offer comfort and freedom of movement. The vests are made from various ballistic materials such as Kevlar, lightweight and flexible Dyneema, and GoldFlex.

The products available range from a basic de-mining apron to a ballistic vest made to specific client specification. Some of the vests can be supplied with panels featuring the company's 3D Comfort Shield™ technology, which offers a built-in ventilation system. This is designed to keep the wearer's body cool in hot climates and warm in lower temperatures.

Protection levels available include Stanag 2920, Stab and NIJ levels. Ballistic plates, ballistic helmets and other safety equipment can be provided to complete the armour package.

Status
Available.

Contractor
International Intelligence Limited.

Guartel Mine Shoes

Development
The Guartel Technologies Mine Shoes are the culmination of years of research and have been designed and developed by a team who have tested and used them in the field.

Description
The Mine Shoes enable the soldier, sapper, commando to traverse a minefield over mud, over water, over any terrain in safety by slipping the compact unit out of the regulation pack and inflating the air cushions.

The Mine Shoes are made of sturdy nylon, nylon-reinforced PVC, coated aluminium and steel alloys. The five air cushions are of a specially

designed and patented material created for maximum strength and resiliency.

Specifications
Weight: 2 to 3 kilos

Status
In service in UK EOD teams in Afghanistan and Iraq and other armies worldwide.

Contractor
Guartel Technologies Ltd.

Londesborough blast resistant boots

Description
Londesborough blast protection footwear has been designed to offer protection from the effects of blast and fragmentation injury using new technology. The design moves away from metal and ceramic plates to a more flexible construction which does not restrict movement and is comfortable to wear.

The boot uppers are made from a combination of protective materials, having an outer and inner surround providing ballistic protection and a central cortex designed to deny the passage of fragments down to 0.05 µm, while blast injury is reduced by a velocity-inhibiting layer. The soles and heels are designed with a unique tread pattern designed to divert the initial kinetic energy thrust outwards instead of upwards. A central cortex bounded by 'sieve' layers preventing the free movement of fragments further reinforces this sole and heel module, while a crumple zone between the protective layers under the foot reduces shockwave injury and foot trauma. The heels and soles are repairable.

Also available are a groin box and protective gaiters.

Contractor
Londesborough Security Equipment Plc.

Mk5 EOD Bomb Disposal Suit

Description
The Mk5 EOD Bomb Disposal Suit is intended to provide bomb disposal operators with improved all-round protection, as well as maximum comfort and flexibility. It replaced the Mk4 suit which has been in use for many years in many countries around the world.

The suit comprises: a jacket with attached collar; trousers; helmet with visor; neck, chest and groin protector plates; spinal protector; separate overshoes; and carrying bag.

The jacket is long-sleeved, of side-opening design and features quick-release straps on the side and shoulder. Rigid chest and groin blast plates can be added to the integral pockets by means of webbing securing straps. The trousers have fully adjustable supporting braces and a Velcro waistband, suitable for small, medium and large sizes. Attached to the front of the trousers is a flexible groin protector held in position by Velcro and elastic.

The ballistic inserts are made of waterproof-treated Kevlar HT that are enclosed in a water-resistant and anti-ultraviolet membrane. The outer cover is supplied in flame-retarding Nomex III, available in navy blue or green. Blast plates are of armoured steel. The suit can also be supplied with the SDMS cooling suit (see separate entry).

The helmet has a GRP skin with an elastomeric aramid core and inner lining, adjustable by means of a 3-point suspension and removable spacer pads that Velcro to the inside. One option is a communication set consisting of a headphone and microphone, plus extension lead for attachment to any VHF radio transceiver; another alternative is a communications system compromising headset, microphone, 100 m of cable and an amplifier, for communication between operator and controller. Incorporated within the helmet is an air ventilation system which directs air flow over the top of the helmet liner, across the visor and down the neck of the operator's face, providing a demisting capability. The addition of an anti-blast neck guard to the bottom front of the helmet closes any gap between helmet and collar. The helmet-mounted torch is powered by rechargeable batteries and the visor is made of hardened acrylic/polycarbonate laminate.

Specifications
Weight
suit (without blast plates): 15 kg (approximate)
suit (with blast plate): 26 kg (approximate)
helmet: 4.7 kg
Power pack: 12 V DC auxiliary output socket to power optional accessories
Air blower: 200 l per min minimum, 3-speed, can accommodate an NBC canister
Protection
suit (without blast plates): 600 m/s
blast plates: 1,400 m/s
helmet: 600 m/s
NATO stock no: NSN 8470-99-990-0090

Status
Available.

Contractor
SDMS Security Products Limited.

Mk5 EOD Suit
(SDMS Security Products Ltd)
1334754

Mk V bomb disposal suit

Description

NP Aerospace has been producing ballistic protective products for over 20 years and engineering mouldings for over 77 years. The British Mk V Explosive Ordnance Suit combined the extensive knowledge of the UK MoD's Defence Clothing Project Research & Support and Dstl Human Factors Research Teams coupled with NP Aerospace's Design & Development Team to produce what was the most advanced suit available.

It has since been surpassed by the Mk VI EOD suite, from the same manufacturer.

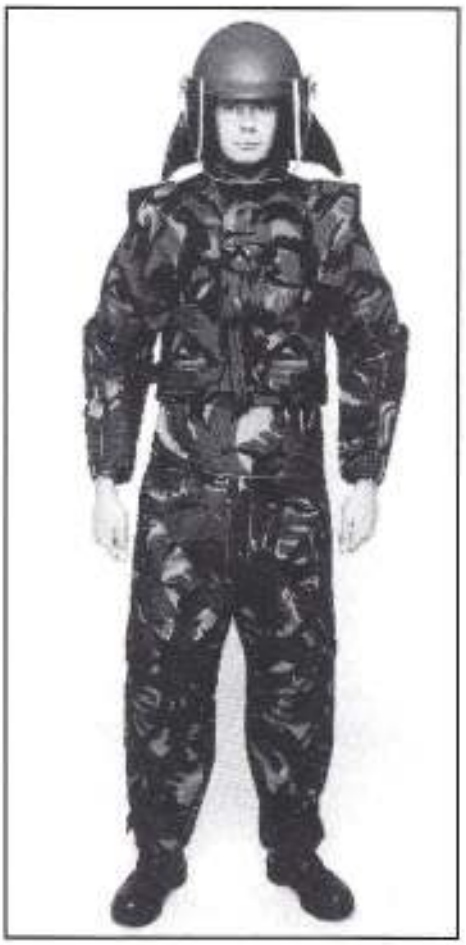
Status

No longer in production.

Contractor

NP Aerospace Limited.

APMS garment (NP Aerospace Ltd) 1041228



Combat EOD suit (NP Aerospace Ltd) 1041226

EOD MkV suit (NP Aerospace Ltd) 1041227

MK VI EOD Suit

Description

The MK VI EOD suit is designed to protect the Improvised Explosive Device Disposal (IEDD) operator. The suit is intended to provide improved protection whilst at the same time allowing substantially improved mobility, flexibility and visibility. The suit consists of a three-piece front plate, helmet and outer suit. The front plate is formed of S2 Glass, Aramid and Closed Cell Foam which is claimed by the manufacturer to provide enhanced blast and ballistics protection. The telescopic construction of the three plates allows flexible movement whilst ensuring that it stays in place and does not rupture during a blast.

The helmet has a heated glass/Polycarbonate visor which is powered by a battery pack located at the rear of the helmet. One battery provides

2 hours of usage. The helmet also contains forced air ventilation to ensure that air exhaled by the user is removed from inside.

The outer suit consists of ballistic protected shorts, leggings and a jacket. The jacket has an integrated load carriage for the front plant. There is also the facility for wrist and waist adjustment. Ventilation is provided by an air intake located on the shoulder. The ventilation system feeds air into the back of the suit at a rate of up to 250 litres per minute. This flow can be controlled by the operator. As with the heated visor the system is powered by a battery back located at the back of the suit. An automatic shut down mechanism is in place to prevent the hot air from a blast entering the system.

The MK VI suit is supplied in five sizes with three sizes of plate available.

Status
In production, developed alongside the British Army.

Contractor
NP Aerospace Limited.

PPE 100 mine boot

Description
Aigis manufactures a range of protection systems employing its patented Technology for Attenuating Blast-Related Energy (TABRE™). Included in the range is the PPE 100 mine boot. Tested by COTEC (Cranfield University Ordnance Test and Evaluation Centre), the PPE 100 Mine Boots offer lower limb protection which is a system comprising outer boots with a TABRE™ sole, removable inner boots and fragmentation protection gaiters. Designed to be comfortable, practical and durable, the PPE 100 is claimed to be suited to a wide range of terrain and climates and has undergone extensive explosive testing with human limbs.

The boots are available in a wide range of men's and women's sizes.

Specifications
Weight: Approx 2 kg each
NATO stock no: 0034-99-003-1138/39/40

Status
In service.

Aigis blast protection PPE 100 mine boots (Aigis) 1375325

Contractor
Aigis Blast Protection Ltd.

RBR 801 search suit

Description
The RBR 801 search suit was developed to meet the particular needs of a search team member. While significantly lighter than the standard 805 bomb suit (see separate entry), the RBR 801 provides the wearer with unmatched mobility and virtually unrestricted movement.

The search suit consists of five separate components:

Jacket
The jacket provides front, back, side, shoulder and neck protection, with the additional feature of armour plate pockets. The high collar is designed to work in conjunction with the RBR full coverage ballistic helmet.

Groin protector
The groin protector can be worn in either the raised or lowered position. When raised, it gives additional protection to the abdomen area.

Arms
Separate sleeves allow optimum mobility.

Trouser
The trousers design provides freedom of movement and maximum protection to the legs.

Helmet and visor
The full ballistic helmet and visor provide protection to the head and neck area.

The ballistic helmet and visor, trousers, sleeves and jacket give Level F2 or F3 ballistic protection; ceramic plates can be added to give Level III/IV protection to the torso.

Status
No longer in production. In widespread service.

Contractor
RBR Armour Limited.

RBR 801 search suit
0518418

RBR 805 bomb suit

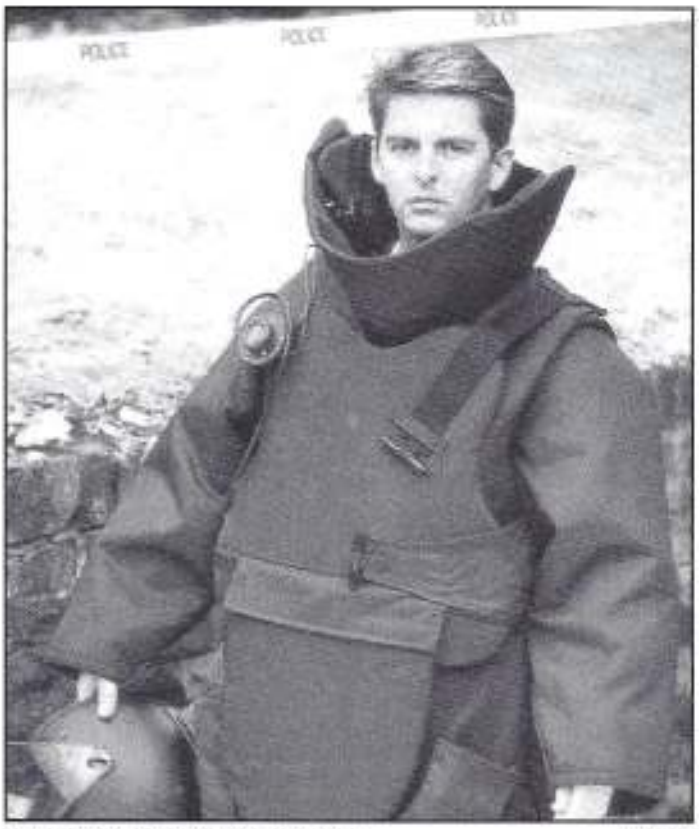
Description
The RBR 805 bomb suit provides comfort and ease of mobility, as well as ballistic protection. It also provides protection against blast, heat and fragmentation.

Jacket
The jacket has been designed to afford maximum comfort, flexibility and mobility. It has fully adjustable sides and an internal elastic belt with hinged groin armour to allow greater flexibility. In addition there are thorax and groin plates for additional blast resistance with a quick release mechanism for rapid removal. On the outside of the jacket are metal hooks for recovery ropes and assortment of pockets to carry communication equipment.

Trousers and overboots
The trousers are a one-piece design, fully armoured at the front. They are fully adjustable at the waist, with adjustable elasticated shoulder straps and adjustable elasticated straps around the knee and calf area. There are wear resistant patches from the knees downward. Overboots can be provided, which can be simply strapped around footwear.

Sleeves
The sleeves are independent of the main jacket, giving greater freedom of movement, and incorporate adjustable back and front fastenings to allow for different shoulder sizes. There is additional length to give protection to the hands and the armour is designed for allowing flexibility.

Helmet and visor
The helmet features a built-in rechargeable demister and helmet cooler (it has a minimum 8-hour run), with a ballistic visor offering a wide field of view. A simple visor attachment allows the visor to be raised or removed and there is ear protection against blast. The neck skirt is Nomex®-covered Kevlar and there is a shock-absorbent internal liner, plus an adjustable harness with one-size fit.



RBR 805 bomb suit (RBR Armour Ltd) 0003553

Cooling assembly
The cooling assembly consists of a fan unit housed in the rear of the vest and a perforated vest which allows cool air to be blown onto the vest and back. A fan blower with rechargeable batteries and 8-hour endurance between charges is fitted. There is also a quick-fit, detachable hose delivering 160 litres of air per minute.

Communication system
This system is optional and can be easily fitted and removed from the helmet. It consists of one earphone and boom microphone which connects to an automatic voice-operated switch VOX or Press-To-Talk (PTT) switch, and then to a suitable radio. It is also possible to utilise a hard wire communication system and recording system.

Status
No longer in production. In widespread service.

Contractor
RBR Armour Limited.

SDMS Ballistic shields

Description
SDMS offers a range of ballistic shields for protection against explosive ordnance fragmentation. They are designed to provide maximum protection, while avoiding a significant loss in manoeuvrability.

The shields are made of multiple layers of compression-moulded aramid material or armoured steel, depending on the requirement. Impact pads are built into the inside surface of the shields to protect against blunt force trauma. The medium and large shields also feature an armoured window for observation. Designs can be adapted for particular requirements.

Specifications
Approximate sizes:
small: 500 × 550 mm
medium: 500 × 1,000 mm
large: 500 × 1,300 mm

Status
Available. In service with police forces, special forces and EOD professionals in many countries worldwide.

Contractor
SDMS Security Products Limited.

A ballistic shield provides additional protection during EOD operations (SDMS Security Products Ltd) 1334751

SDMS Cooling suit

Description
The SDMS Cooling suit uses ice water to remove excess body heat without the requirement for hazardous pressurised containers or toxic cooling agents. Its cooling capability allows EOD operators to work with greater efficiency and concentration, and is suitable for use with the Mk4 and the Mk5 EOD Bomb Disposal Suit from SDMS (see separate entry).

Made from fire-retardant Kermel material, the suit also offers protection against heat and flash fireballs. The suit comprises a 1-piece garment

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covering the upper body, upper arms and legs, as well as a close-fitting open-faced hood, a cooling pump and pouch, two water bottles, battery pack and carrying bag. One size fits all. The cooling unit is powered by the 12 V pump, uses solid ice and water and features an on/off flow rate control.

Specifications
Weight:
suit: 1.0 kg
cooling unit, dry: 0.5 kg
ice: 1.5 kg
water: 0.5 kg
pump unit: 1.0 kg
Power (control unit): 12 V from suit power supply
Heat removal rate: 270 W (full suit)
Endurance: 45 min at 35°C (95°F)

Status
Available.

Contractor
SDMS Security Products Limited.

SDMS cooling suit
(SDMS Security Products Ltd)
1334755

SDMS Search Suit

Description
The SDMS Search Suit was designed specially for those involved in searching for and clearing mines and terrorist explosive devices. Although the Search Suit does not offer the higher level of protection of the Mk 5 Bomb Disposal Suit (see separate entry), it is much lighter, more comfortable and allows virtually unrestricted movement.

The outer material of the suit is made from fire-retardant Nomex III and incorporates the latest Kevlar® technology fibres. The suit has a pocket into which an optional armoured steel plate can be inserted for extra protection.

The complete Search Suit comprises: a jacket which provides front, back, side, shoulder and neck protection and which includes the up-armouring pocket; arms, with separate adjustable sleeves; a removable groin protector insert; trousers; and helmet with acrylic/polycarbonate visor. It is supplied in navy blue or olive green.

Specifications
Protection:
arms, jacket, groin protector and trousers: V50 STANAG 2920 – 475 m/s
helmet: V50 STANAG – 450 m/s
visor: V50 STANAG – 450 m/s
NATO stock no: 8470-99-233-1238

Status
Available.

Search suit
(SDMS Security Products Ltd)
1334756

Contractor
SDMS Security Products Limited.

SES Mark 4 EOD suit

Description
Although no longer in production, the SES Mark 4 suit is reported to be in service with EOD teams throughout the world. The suit was designed to give the highest level of protection with maximum comfort and flexibility for the user. All ballistic inserts are made of waterproof-treated Kevlar, enclosed in a special water and anti-ultra-violet ray membrane. The outer cover is available in a variety of flame retardant materials including Nomex III; an optional fire retardant hygienic undergarment is available on request. The ballistic levels and materials used in the various components of the Mark 4 suit are tested and evaluated to the full quality assurance standards laid down by the appropriate government authorities.

Armoured helmet
The helmet is fully adjustable to various sizes for perfect fit by means of a three-point suspension and removable spacer pads held by Velcro to the inside. Incorporated in the helmet is a communication set consisting of

two headphones with one microphone and extension lead for attachment to any VHF radio transceiver.

Fixed to the top of the helmet is a fresh air blower inlet pipe. This directs the flow of forced air over the top of the helmet liner, across the visor and down over the operator's face, ensuring efficient demisting and a clear view. The addition of a Kevlar flexible neck guard to the bottom front of the helmet closes any possible frontal gap between helmet and collar.

Jacket

The jacket is a long-sleeved side-opening design filled with flexible Kevlar armour. The high collar provides overlap protection to the helmet, visor and neck guard. Provision is made on the front for the attachment of rigid chest and groin blast plates by means of integral pockets with webbing and Velcro securing straps.

Pouches for working tools, blower and radio are attached to the front and back of the outer cover. Immediate removal of the jacket is achieved by use of the quick release straps attached to the side and shoulder.

Trousers

The trousers have fully adjustable supporting braces and wide Velcro waistband catering for all sizes. Attached to the front is a flexible groin protector, retained in position by Velcro and elastic. At the rear of the legs a full-length Velcro strip is used in conjunction with the retaining straps to fix the articulated flexible armour in position.

Overboots are an integral part of the trousers and are held in position by Velcro, leather and webbing straps.

Air blower/fan

The air blower/fan unit is fixed to the rear of the jacket by a removable Velcro- and press-stud-fastened panel. The unit consists of the fan, with replaceable filters and separate rechargeable battery pack. Two Velcro retaining straps are fixed to the side of the panel to secure the radio extension lead that comes from the helmet.

Specifications

Weight

jacket: 11.3 kg
trousers: 4.6 kg
plates: 3.7 kg
helmet: 4.5 kg
fan unit: 1 kg
battery: 1.5 kg

SES Mark 4 EOD suit 0515959

Status

No longer in production. In service with EOD teams throughout the world.

Contractor

M L Lifeguard Equipment Limited (now Beaufort Air-Sea Equipment Limited).

United States

Cobra seating system

Development

Global Seating Systems (GSS) LLC have a 25-year background in the production and development of seating systems. The company produces a family of seating systems which cover nearly all types of vehicles including HMMWVs, MRAP (Mine Resistant Ambush Protected) and Heavy transporters. One of the family of seating systems is the Cobra. GSS were approached by the US Army's Tank Automotive Research, Development and Engineering Centre (TARDEC) in 2003 and asked to produce replacements for the seats contained in 5 ton utility trucks. After modification and testing, approximately 4,000 Cobra seats were installed in vehicles in Kuwait.

Description

There are currently approximately 5,000 to 6,000 vehicles in theatre which have Cobra seats installed.

Original testing was carried out by US FMVSS (Federal Motor Vehicle Safety Standards and Regulations) but, as the threat has evolved in south-west Asia, the modifications have been extended.

The Cobra seat is designed to be a blast mitigating seat to protect against a variety of mine-blast/IED (Improvised Explosive Device) and EFP (Explosively Formed Projectiles) front, rear and side impacts. GSS has conducted many tests on its seating systems both in vehicle platforms and in test labs. Tests have been carried out with detonations in all possible areas. Tests have included crash/accident related impacts: frontal, rear/convoy, lateral, and rollover, vertical impacts (IED and mine blast) in both the blast and slam down events. Testing has been carried out at the US Army Aberdeen Test Center, US Army Research Laboratory and US Army Yuma Test Site.

Protection is a field which constantly needs to be modified as threats evolve, in particular against EFP which are currently taking a heavy toll in Iraq. In order to fulfil this requirement, ballistic shielding can be fitted to the back and underneath of the seats to provide extra protection.

A full ergonomic evaluation has been carried out on the seats with regard to operator comfort. A female operator will have different measurements to that of a male so therefore will need different dimensions such as height in order to be able to see over a dashboard and so on. Therefore height rises are adjustable and arm rests are available, if required.

Some convoys travel up from Kuwait into Northern Iraq which is approximately an 18 hour drive. A journey such as this requires full spinal support and without this reinforcement it can have an adverse affect on the lumbar region and posterior. With this in mind, the Cobra has a removable back panel to accommodate a water pack. Without this, the soldiers water supply can push them up to 4 inches forward, resulting in discomfort.

The Cobra seat has all of its seatbelts mounted to the seat rather than fixed to the vehicle. The primary reason for this is so that in the event the vehicle takes a blast, the soldier will not become uncoupled from the seat thus reducing spinal cord or brain injury.

Features of the Cobra seating system (Global Seating Systems LLC) 1334734

Front view of the Cobra seating system (Global Seating Systems LLC)
1334736

Rear view of the Cobra seating system (Global Seating Systems LLC)
1334736

The Cobra's 4-way adjustable headrest provides additional protection from vehicle collisions. A fixed, integrated headrest is also available as an option.

The seat has a five-point restraint to ensure that the occupant's upper and lower torso are well restrained in order to optimise and maintain spinal alignment throughout both the blast and slam down event even if there is seat displacement and to eliminate the potential for submarining under the lap seat belt.

The Cobra seat is available in different configurations depending on the vehicle. The width of the seat can be 55.8 cm when fitted into a heavy transporter, 45.7 cm for MRAP and 41.9 cm in for light vehicles.

The seats can be bolted to the floor, mounted on adjustable risers, fitted for an suspension system or cantilevered from the vehicle sidewall. They can be installed in any vehicle platform without regard to securing restraint systems to B pillars or other solid body structures.

Status
In production. In service with US and Canada.

Contractor
Global Seating Systems LLC.

Interspiro mask for CBWD, EOD and firefighting

Description
The Interspiro chemical warfare mask was jointly developed by Interspiro Inc of Connecticut, USA and Interspiro AB of Lidingö, Sweden, under contract to the US Air Force Aeronautical Systems Center at Eglin Air Force Base, Florida. Following First Article Testing the mask was approved by the US Air Force for service in September 1994. Under the development contract, the US Air Force has received over 9,000 units.

The Interspiro chemical warfare mask is intended for firefighting applications and provides the capability of selecting a breathing source from either a Self-Contained Breathing Apparatus (SCBA) or filtered air through a chemical/biological filter canister. The mask has subsequently been adapted to military EOD requirements as well as civil applications for counter-terrorism protection from weapons of mass destruction.

The mask is provided as part of a kit designed to be used with the Interspiro Spiromatic 9030 Self-Contained Breathing Apparatus (SCBA). This SCBA is the standard US Air Force equipment with Interspiro contracted to deliver over 16,000 units. The kit includes a mask, three protective hoods, three C2 filter canisters, a waterproof bag and a canvas carrying case. In a chemical warfare threat environment the user replaces his standard SCBA mask with the chemical warfare mask. If required the mask can be worn without the SCBA. If the SCBA is in use, the user can switch from the filter respiration mode to a compressed air supply by engaging the positive pressure selector on the breathing valve. Conversely, the user can switch back to the filter mode by turning off the positive pressure switch.

The system has been modified to remove the hood and allow direct interface with the Joint Service Lightweight Integrated Suit Technology (JLIST) style clothing.

Interspiro chemical warfare mask for firefighters
0513478

Status
In production. In service with the US Air Force, Army and Marine Corps.

Contractor
Interspiro AB.

Self-contained Toxic Environment Protective Outfit (STEPO)

Description
The Self-contained Toxic Environment Protective Outfit (STEPO) provides protection in highly toxic, unknown or oxygen-deficient environments that pose an immediate danger to life and health. This system was designed, developed, prototyped, and extensively tested by GEOMET. The STEPO system is an OSHA Level A system that provides protection against Chemical Warfare Agents, toxic industrial chemicals (TICS), petroleum oil and lubricants (POLs), and rocket fuels. The system consists of the following components:

- Totally encapsulating protective suit
- NIOSH approved, 4 hour, closed-circuit Self-Contained Breathing Apparatus (SCBA)
- Personal ice cooling system
- Communications interface compatible with military and commercial radios.

The protective suit is constructed from a multilaminate material that provides chemical protection and flame resistance and also dissipates static electrical charges. The outside of the material is coloured light grey to reduce solar loading. The suit is available in four sizes and has a vapour-proof slide fastener closure (front entry), enlarged back to

accommodate an SCBA inside the suit, anti-fogging visor and flexible glove cuff interface.

The closed-circuit SCBA (commonly referred to as a rebreather) provides respiratory protection for a 4-hour duration. When the user exhales, the rebreather scrubs the carbon dioxide from the exhaled breath, adds fresh oxygen and cools the mixture prior to inhalation. This process provides 4 hours of uninterrupted breathing using only 0.59m³ of compressed oxygen. An open-circuit SCBA and/or supplied air hose can also be used with the STEPO suit.

The Personal Ice Cooling System (PICS) is used to manage heat stress. The system uses ice to cool water that circulates through a liquid cooling garment to remove metabolic heat form the user's body. The ice supply is mounted on the outside of the suit so it can be replaced for continued cooling.

Status
In production.

Contractor
GeometTechnologies LLC (prime contractor).

Self-contained Toxic Environment Protective Outfit (STEPO)
0568686

ShockRide®

Development
ArmorWorks began developing their seating systems in 2001 with multiple grants from the US Army and US Marine Corps. They developed the second-generation Energy Attenuating (EA) seating system in Q4 2006 and delivered the first prototypes to BAE Land Systems in January 2007. ShockRide® LLC was formed in January 2008 and is a division of ArmorWorks.

The ShockRide® family of Mineblast Attenuating Seats were designed for Improvised Explosive Devices (IED) and mineblast protection for safeguard against spinal injuries to troops exposed to mine blasts. The BASS (Bradley Advanced Seating System) seats were designed for the rear troop seating area of an M2 Bradley Infantry Fighting Vehicle (IFV). The seating programme was started in order to provide protection for crew members from high lumbar forces that are released during an IED or mine blast.

Description
ArmorWorks, LLC and ShockRide® have developed separate designs for troop, driver and commander seats. These include stand-alone seats as well as a bench system. ShockRide® seating systems do not use hydraulic pneumatic struts.

The ShockRide® family of seats can be designed to tailor the amount of load into each seat.

The non-bench seats can be adjusted to ensure greater comfort and ease of movement for the driver and commander.

The Energy Attenuating (EA) seating system has been live fire tested at Aberdeen Proving Ground (APG) and is US-government approved for ground vehicle use. The system is able to reduce both the initial blast input and the slam down input.

All seats are US Federal Motor Vehicle Safety Standard (FMVSS) certified and have demonstrated a loading capability to FMVSS 207. All seat materials meet flammability requirements of FMVSS 302.

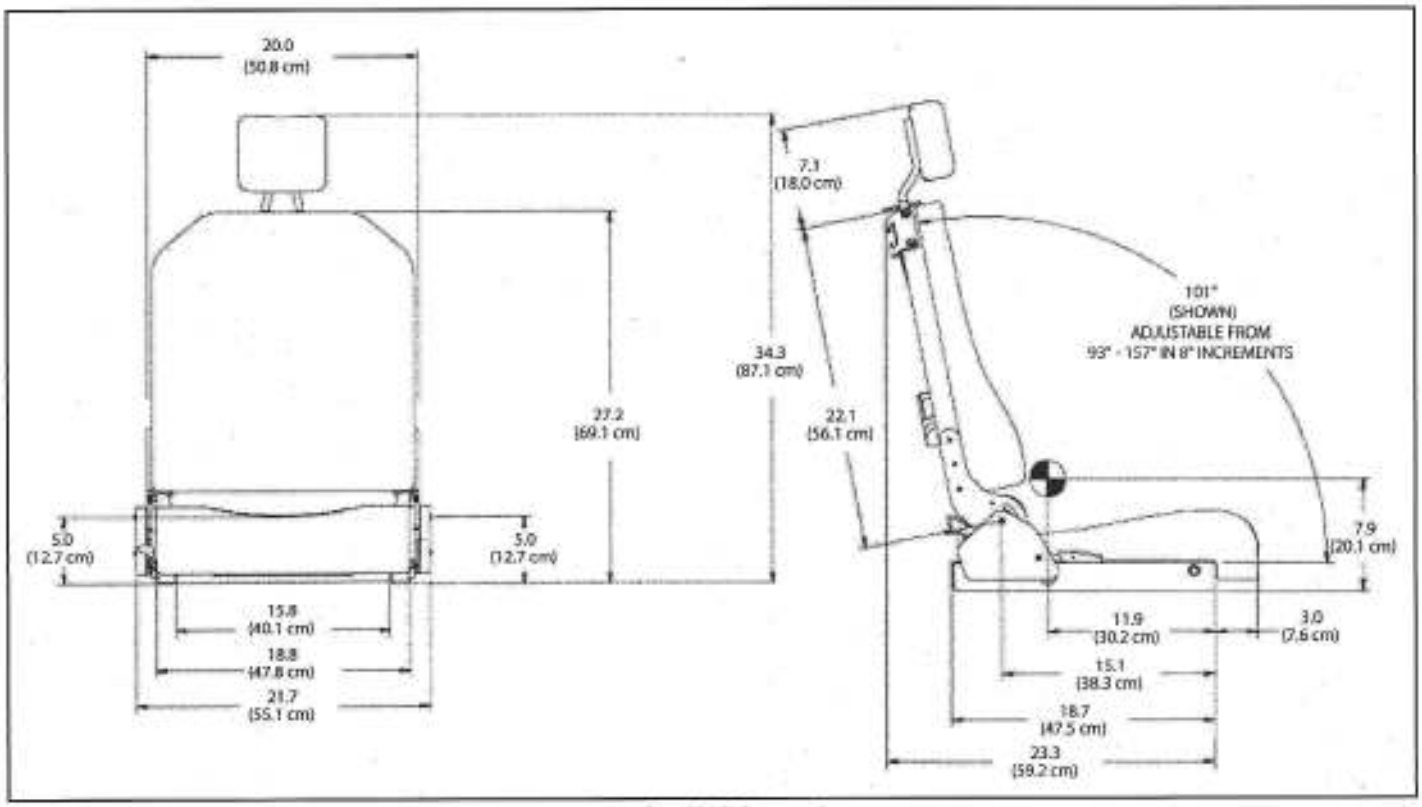
ArmorWorks have seats either selected for production or in prototype and evaluation stages for more than seven MRAP, JLTV and tracked vehicle programmes with BAE, Textron Land & Marine Systems, General Dynamics Land Systems, General Dynamics Land Systems Canada, and AM General.

Specifications
Weight: 29 kg (63 lb)
See line diagram for dimensions data.

Status
Since its inception, ShockRid®e LLC has delivered over 24,000 seats.

ShockRide® seats are to be installed in more than 400 BAE Systems' Mine Resistant Ambush Protected (MRAP) vehicles to be used by the

Mine Blast Driver/Passenger Seat (BAE Systems) 1334728



Line diagram showing dimensions of Mine Blast Driver/Passenger Seat (BAE Systems) 1334729

US Army and US Marines Corps. As of January 2009, ShockRide® has delivered its 1,000th mine blast seating vehicle set to BAE Land Systems.

Contractor
ArmorWorks.

Wellco blast protective boots and overboots

Description
Wellco manufactures a blast-protective boot and overboot, which were developed by its subsidiary, Ro-Search Inc. For many years the outsole was made from direct moulded vulcanised rubber. Both the boot and overboot have been upgraded by replacing the rubber outsole with one of direct injected polyurethane with rubber cleats for wear. The polyurethane outsole is thicker, putting the foot higher above the blast, and lighter than rubber. It also provides increased shock absorption and comfort.

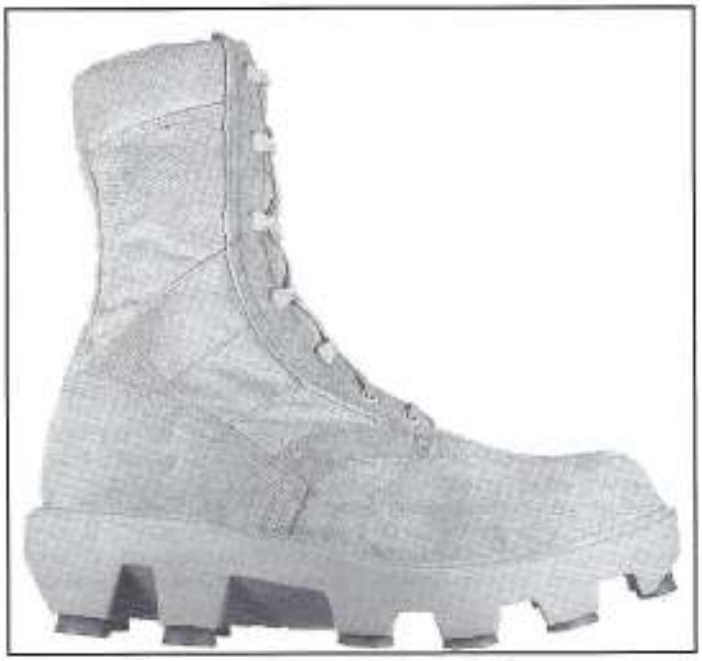
The boot is designed to provide comfortable protection during all-day wear. The overboot is intended for use during surveying and clearing operations and can be worn with the protective boot for maximum protection, or with any other combat boot.

Both the boot and the overboot have a wedge of metallic honeycomb (attenuator) sandwiched between a specially shaped outsole and a multilayer Kevlar insole. This design deflects and absorbs the blast from anti-personnel mines, while protecting the foot from penetration.

In addition to supplying the US Army, Wellco supplies boots and overboots to various countries through US State Department contracts for demining efforts around the world.

Contractor
Wellco Enterprises Inc.

Wellco Blast Protective overboot, boot and sole (Wellco) 0122863



Wellco Blast Protective with desert tan upper (Wellco) 0122864

TRAINING AIDS/SIMULATORS

Canada

MIL Mine Effects Simulator (MES) system

Description
The MES system was developed as a realistic training tool for both military units and humanitarian organisations. It can be used for mine awareness, clearance and breaching training without compromising the safety of personnel.

The interactive two-part system comprises a mine and a vehicle/personnel mounted hit indicator. When the mine is activated a signal is transmitted and is received by the Hit Indicator Unit (HIU). This in turn activates a strobe light or smoke unit for the vehicle, or a strobe light/audible alarm on the personnel indicating a 'hit' to other vehicles, the crew, ground forces and directing staff.

The mines are reusable, contain no explosives and re-arm themselves after each contact. The anti-personnel mine is pressure actuated while the anti-tank mine has a Full Width Attack (FWA) fuze with programmable settings.

Specifications

Anti-tank MES	Mine	HIU
Material	Moulded urethane	Injection moulded structural foam
Size	235 diameter × 120 mm height	97 diameter × 48 mm height
Weight	4.1 kg	5.4 kg
Control	Electronic FWA fuze	Electronic
Power	9 V alkaline battery pack	12 V Ni/Cd
Safety	Safety pin (contains no explosives)	Secured switch

Anti-Personnel MES		
Material	Moulded urethane	Injection moulded case
Size	97 diameter × 48 mm height	102 × 83 × 25 mm
Weight	295 g	250 g
Control	Pressure actuated fuze	Electronic
Power	12 V alkaline	9 V alkaline
Safety	Safety clip (contains no explosives)	Key switched, coded transmission reset

Status
Current status unknown.

Contractor
Military International Limited.

MIL Mine target module simulators (ATMS and APMS)

Description
The mine target module simulator system is designed as a training tool for mine detector and prodding techniques and for comparison testing of minimum metal mine detectors. The solid body is fabricated from green coloured urethane and two sizes are available to simulate both Anti-Tank (AT) and Anti-Personnel (AP) mines. Eight interchangeable low metal targets are supplied with the metal components set into a cylinder of clear plastic 1.35 cm in diameter and 3.98 cm long.

Specifications
Test targets:
- Aluminium 45 long × 6 mm diameter
- Aluminium 10 long × 6 mm diameter
- Mild steel 4.74 long × 4.74 mm diameter
- Non-magnetic stainless steel 4.74 long × 4.74 mm diameter
- Mild steel 19 long × 1.59 mm diameter
- Non-magnetic stainless steel 19 long × 1.59 mm diameter
- Brass ball 4.67 mm diameter
- Steel ball 4.76 mm diameter

Size
- ATMS: 25 diameter × 8.5 cm
- APMS: 8 diameter × 4.5 cm

Weight
- ATMS: 4.1 kg
- APMS: 210 g

MIL anti-tank mine simulator (MIL) 0074104

Status
Current status unknown.

Contractor
Military International Limited.

United Kingdom

Aerial delivered land mine disposal training system

Description
Pennant International has developed a Reactive Submunitions Training Model (RSTM) system, which provides a safe, practical and realistic method of training EOD personnel in the techniques for the clearance of aerial delivered landmines.

The RSTM system uses approved pyrotechnics to generate both noise and smoke to simulate detonation. An integral noise generator is also available for indoor use, or when the anti-handling sensor has been selected. The simulated mines include attachments which can represent differing threats by providing the ability to change the shape and character of the training munition. Realistic training scenarios can be created with representative mines, or submunitions, scattered over a wide area. The rugged nature of the RSTM system allows it to be deployed in all weathers.

The system has four major reusable elements:
- a reactive model providing visual (flash and smoke) and audible simulation of detonation, from a range of preselectable initiation mechanisms: laser, anti-handling and internal timer. The instructor can remotely test, set and reset any reactive model

RSTM simulated munitions (Pennant Training Systems Ltd) 0077234

- a dummy model externally indistinguishable from the reactive model used in conjunction with the reactive model to provide realistic numbers in typical training scenarios
- eye-safe laser projector which is fitted to the selected weapon and used by the trainee to initiate detonation of a reactive model as part of the appropriate render safe procedures
- a hand-held programming device enabling instructors to test and set up individual reactive models without direct contact.

Typical training would involve instructors creating a minefield with reactive and dummy models. The reactive models can be individually set to respond, that is detonate, in a predefined way using the programming device. The reactive model can be replenished with pyrotechnic material and reused.

As of December 2007, Pennant Training Systems Ltd won a Subcontract with BAE Systems Insyte to provide Computer Based Training. The courseware is likely to be delivered by August 2008.

Status
Supplied to the British army.

Contractor
Pennant Training Systems Limited.

RSTM programmer
(Pennant Training Systems Ltd)
0077233

Argon Electronics CAMSIM chemical-agent monitor training system

Description
Produced by Argon Electronics, CAMSIM is a comprehensive training system based on the Smiths Detection Chemical Agent Monitor (CAM). Not only does the simulator enable a user to be trained in the detection of blister agents and nerve agents, but it also assists in the evaluation of a trainee in the correct use of the CAM.

Using electronic simulation technology, both wide area and point contact agent contamination simulation is possible. A simulation confidence-check device is included with the system. The need for a radioactive source or environmentally harmful simulation chemicals is avoided.

In order to ensure effective training, CAMSIM is able to detect and record the following user errors (see illustration):

- failure to use the confidence check (an optional regular check error is also available)
- incorrect mode change between agents
- probe contamination
- instrument overload
- incorrect instrument shut down
- attempt to change mode during a wait period.

Errors are displayed on the simulator in BAR format on the insertion of a special instructor's key. Only an instructor can read or erase errors once they have occurred.

CAMSIM includes the simulation of partial and full decontamination of chemical agents. Decontamination training is electronic and completely under the control of the instructor.

Comprehensive data logging permits each operator error to be recorded on the basis of the time occurrence and duration of the error. In addition, missed agent errors are also detected. This records any instance where the operator encountered either simulation nerve or blister agent but had the detector either turned off, or the incorrect mode was selected at that time.

If the simulator is switched to blister and an area contaminated with nerve agent is entered, the time, duration, detection mode and level of simulation agent encountered will be recorded. The time at which the simulator is switched on or off and selection of the agent mode is also recorded.

An interface with a personal computer permits thorough analysis of a training session together with permanent training records produced on a printer. Changes in operator ability can be readily determined by comparison with records from previous training sessions.

Standard and optional error reporting can be customised to suit specific organisational operating procedures. Radio control of both the CAMSIM001 and simulation sources is also available. A Global Positioning System (GPS) based option is available to enable large areas of vapour contamination to be simulated. Simulated nerve and blister agents can be varied in strength and location throughout a training area as required by the instructor. Options can be upgraded at a later date if required.

The CAMSIM detector simulator responds to electronic sources that simulate chemical vapours, toxic industrial substances or false positives. This means that training does not involve using simulants which can harm the environment, saturate the training area or pose any health and safety risk to trainers and students. The sources can be used in any location, including within public buildings. Most scenarios can be set up in less than 10 minutes and because trainers control the sources, their scenario will not have changed when it is time for the exercise. CAMSIM is designed to be fully compatible with the PlumeSIM system for instrumented collective wide area training.

CAMSIM works on all the same battery types as the real detector. It requires no preventative maintenance and spares are minimised to cost of ownership. Expensive damage to real detectors is avoided in order to maintain operational readiness.

CAMSIM can simulate:

- Nerve, blister, blood, choking agents* and false positives
- Contamination, decontamination and persistency
- Effects of wind direction and temperature
- Depletion of batteries
- Nozzle contamination contact with solid surfaces
- Confidence testing procedure
- Correct insertion and removal of dopant (ECAMSIM only)

*As applicable to the version of CAM simulated including ECAM and ICAM

Instructor remote control: A simple instructor remote gives the trainer total control of the exercise. This enables the effectiveness of decontamination drills to be decided by allowing trainers to control the remaining contamination, and for water to be used for decontamination to avoid damage to assets and the environment. Scenarios can be set for subsequent exercises. The same controller can be used to simulate persistency and the effects of wind or temperature.

CAMSIM001 realistically simulates contaminated personnel, vehicles, munitions, stores and ground areas 0085454

CAMSIM ERRORS - G
1 - CAMSOFT LOG MEMORY FULL
2 - CAMSOFT LOG MEMORY NOT CLEAR
3 - PRESET G/H ENABLED
4 - WARM UP WITHOUT END CAP
5 - SLOW / NO NOZZLE FILTER
6 - SLOW / NO ENVIRONMENTAL END CAP
7 - DID NOT CONFIDENCE TEST G AND H
8 - MORE THAN 1 SEC OF CONFIDENCE TEST
© 1999 Argon Electronics
G 1 2 3 4 5 6 7 8
CAM416

Trainee errors are logged by CAMSIM001; the error card shown here can be printed in any language 0085455

Training in the use of complementary equipment types with common simulation sources: The simulation systems are designed to enable realistic simultaneous training in detection instruments that work on different technology principles. CAMSIM is compatible with other simulators designed by Argon Electronics, including AP2C-SIM, LCD-SIM, RAID-M-SIM (see separate entries) and the HAPSIM-P probe, permitting multidetector and substance training to take place within the same training scenario. The electronic simulation sources can represent false positives, as well as CW agents applicable to the type of CAM simulated, enabling the CAM's appearance and functions to be accurately replicated in a safe, practical manner.

Error reporting for after action review: Students are required to set up and use the detector simulator following the procedures for the real detector. If this is not done, the simulator records the mistakes made and the instructor is able to switch the device to display a detailed and indisputable error report after the exercise.

Status
In production. In service with the US Army, US Air Force, US Marine Corps, US Navy, Department of Justice, National Guard, UK Police and Organisation for Prohibition of Chemical Weapons. Also in use at the Belgian, Italian and Norwegian, Spanish, and Thai NBC schools and in service with the armed forces of Australia, Canada, Greece, Singapore, South Africa and the United Kingdom.

Contractor
Argon Electronics.

Argon Electronics LCD-SIM chemical detector training system

Description
The LCD-SIM detector simulator responds to electronic sources that simulate chemical vapours, toxic industrial substances or false positives. This mean that trainers no longer need to use simulants which can harm the environment, saturate the training area or pose potential health and safety risks to trainers or students. The sources can be used in multiple locations, including within public buildings. Most scenes can be set in less than 10 minutes. LCD-SIM is compatible with the PlumeSIM system for instrumented collective wide area training.

The LCD-SIM Chemical Detector Training system (Argon Electronics LLP) 1325793

LCD-SIM can simulate:
- nerve, blister, blood, choking agents and false positives
- contamination, decontamination and persistency
- effects of wind direction and temperature
- depletion of sieve packs and batteries
- cumulative dose and dose alarms
- blocked breather
- confidence testing.

Instructor remote control
A remote provides trainers with control of the exercises. Scenes can be instantly re-set for the next exercise. The same controller can simulate persistency and the effects of wind or temperature.

Simulation training for common equipment types
Argon simulation systems enable realistic simultaneous training in detection instruments working on different technology principles. LCD-SIM is compatible with other simulators designed by Argon Electronics, including AP2C-SIM, CAMSIM, RAID-M-SIM and the HAPSIM-P probe, permitting multidetector and multisubstance training at the same time. The electronic simulation sources can represent false positives, as well as chemical warfare (CW) agents and toxic industrial chemicals (TICs), enabling the LCD's appearance and functions to be accurately replicated in a safe, practical manner.

Error reporting for after action review
Students are required to set up and use the detector simulator following the procedures for the real detector. If this is not done the simulator records the mistakes made and the instructor is able to switch the device to display a detailed and indisputable error report after the exercise.

Cost-effective training
LCD-SIM works on the same commercial battery supply as the real detector. LCD-SIM requires no preventative maintenance and spares are minimised to costs.

Status
In production. LCAD-SIM variant in service with UK DEODS.

Contractor
Argon Electronics LLP.

D-SIM depleted uranium residue simulator

Description
The D-SIM system permits easy training in the clearance of Depleted Uranium (DU) residue. Using safe chemicals to simulate the residue enables instructors to teach the detection of:

- DU residue
- munition target entry points
- DU munitions.

Conventional or model munitions can be easily treated to appear radioactive. Simulants are available as different coloured powders (grey or green), liquid or ink. The system package includes simulated detector (available in different styles), simulation powders, liquid and a carry case.

Status
In production. In service with military, nuclear and civil organisations worldwide.

Contractor
Argon Electronics LLP.

The D-SIM Depleted Uranium Residue Simulator
(Argon Electronics LLP)
1326791

EOD training devices

Description
SDMS can supply a wide range of inert improvised explosive devices (IEDs).

Each IED is authentic in every detail to actual terrorist devices (other than containing only dummy explosives) and has fully functioning electronic and/or mechanical components. Each IED provides accurate X-ray signatures, ideal for EOD and search training. Available devices include:

Radio cassette bomb: based on the IED used to bring down Flight PA103 over Lockerbie in 1988. This device consists of approx 300 g of simulated Semtex-H explosive, electric detonator, barometric switch, PP3 cell, arming switch, PCB timer and sound unit to simulate explosion.

Car Bomb: a type of model IED mimicking under-vehicle booby traps that have been used successfully to target individuals in the past. Strong magnets enable the device to be fitted to he underside of a vehicle.

Incendiary device: a clear perspex container featuring dummy explosive material, timer, initiator, arming switches, batteries and fuel capsules to enhance the incendiary effect.

35 mm camera bomb: a standard compact camera containing dummy explosive and detonator.

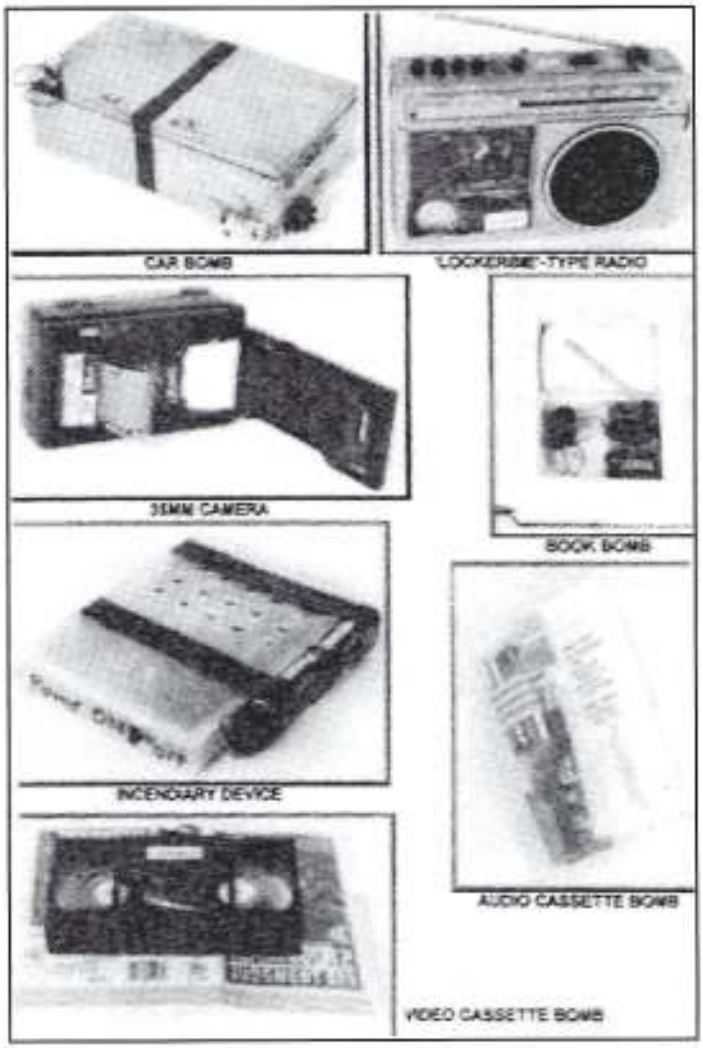
Video Cassette bomb: a video cassette containing dummy explosive, detonator, batteries, timer and arming switch.

Book bomb: a hollowed out book containing a fake IED.

Audio cassette bomb: similar to the video cassette training device, the dummy IED is contained within an audio cassette.

Status
Available to authorised customers.

Contractor
SDMS Security Products Limited.



A range of training IEDs is available
(SDMS Security Products Ltd)
0074378

Landmine surrogates

Description

C King Associates Ltd (CKA) is a small company specialising in high-level consultancy on the technical and procedural aspects of mine clearance and Explosive Ordnance Disposal (EOD) (see separate entry under *Consultancy – services*). The company's director is editor of *Jane's Explosive Ordnance Disposal* and *Jane's Mines and Mine Clearance*, with extensive practical experience of both military and humanitarian EOD operations.

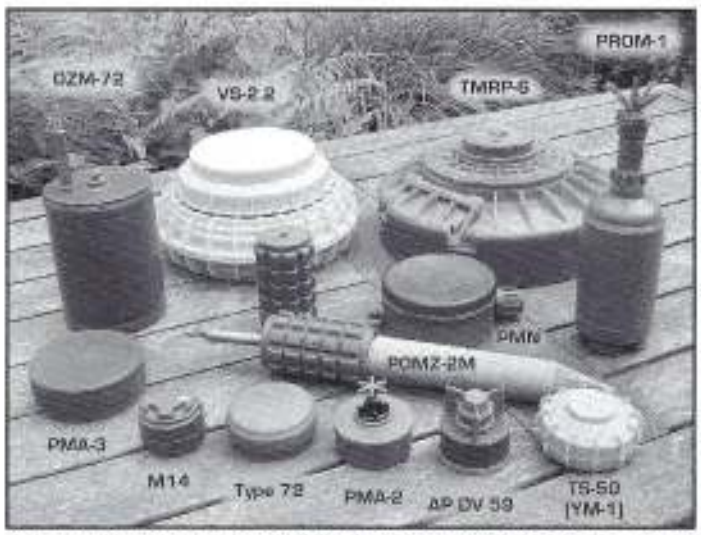
CKA is licensed by the British government to hold inert examples of landmines for the purposes of research and analysis. Their collection includes most of the anti-personnel mines and submunitions currently found in mine-affected regions, numerous types of anti-tank mine and examples of other ordnance. The collection allows mine components to be analysed in detail so that accurate replicas can be located or fabricated. CKA also maintains a comprehensive image library with more than 10,000 landmine and UXO photographs from around the world.

In response to customer requests, the company has manufactured a range of surrogate landmines for detection trials and training. Originally developed for the European Joint Research Centre, both generic and model-specific anti-personnel mine surrogates are available; these have been supplied to the Japanese, US and UK governments, as well as to several commercial companies involved in research and development.

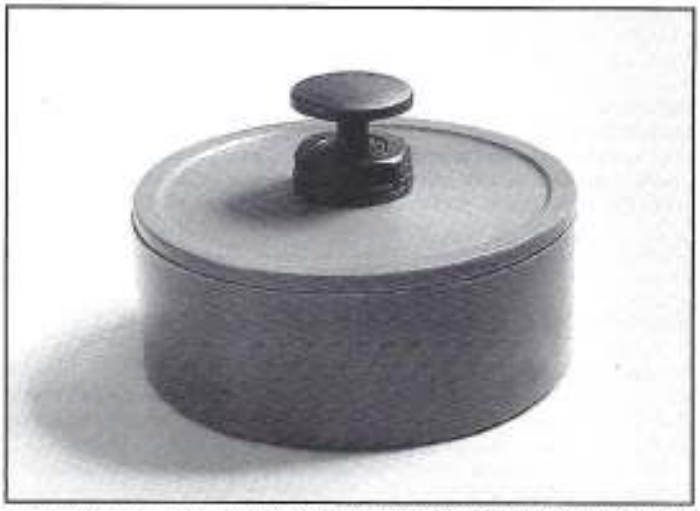
Type-specific surrogates

Type-specific surrogates include:

- Yugoslav PMA-1, PMA-2, PMA-3, PROM-1, TMA-5 and TMRP-6
- Russian PMN, POMZ-2M and OZM-72
- Italian VS-50, TS-50 and VS-2.2
- US M14 and M18A1 Claymore
- Chinese Type 72, French MI AP DV 59, Iranian YM-1.



A range of landmine surrogates available from CKA (Colin King) 1325199



The CKA modular mine surrogate incorporates a working 'fuze' mechanism which registers actuation (Colin King) 1041062

A reloadable 'active' version of the POMZ-2M is also available; this is identical to the real mine but fires a shotgun cap when triggered.

These surrogates are moulded in epoxy resin, either colour matched to the original or to the customers requirements. Mines intended for detection training contain exact duplicates of the real metallic components and can be filled with microcrystalline wax (see below), which closely represents the dielectric properties of the explosive filling.

Modular Mine Surrogate

The Modular Mine Surrogate (MMS) was designed to meet the diverse needs of both research engineers and the field operatives for equipment testing and training. Initially, the primary requirement was to assess the performance of detection instruments – both metal detectors and dual-sensor (metal/radar) locators. However, recent requirements have also included the evaluation of mechanical mine clearance equipment and explosive line charges.

The explosive substitute used in the MMS is a high melting point microcrystalline wax, which not only has the same electrical properties as TNT, but also has similar mechanical characteristics. Metal content can be varied from nil, through the sub-gram quantities typical of minimum-metal mines, right up to the 8 g CCW threshold.

The most innovative feature of the MMS is a working 'fuze', which registers initiation at a typical actuation pressure (10 to 20 kg). This system uses a simple non-metallic ratchet mechanism to indicate clearly whether the mine would have been initiated by the detector operator, mechanical clearance equipment or line charge. This is particularly valuable for the training and evaluation of deminers, since other methods do not indicate whether a mine would have been initiated during the detection and uncovering process.

The MMS is fully compliant with the specifications defined in the CEN Workshop Agreement (CWA 15044) for mechanical testing.

Contractor

C King Associates Limited.

Military training aids

Description

Miltra Engineering Limited has specialised in the manufacture of military training aids for over 20 years. Miltra can offer a wide range of products including EOD training aids, specialist training products and scale models individually designed to meet user-defined specifications.

Miltra produces a wide range of training aids (Miltra Engineering Ltd) 0543381

The most recently developed product is the Miltra Training Aid Multiple Munitions Sets (TAMMS) series of EOD training products. These include full-size aerial bombs and bomb fuzes, submunitions, mines and

Miltra produces a wide range of training aids (Miltra Engineering Ltd) 0543380

SECTION 4

improvised explosive devices. AllTAMMS are supplied in durable packing/storage cases with contents listing and operational instructions.

All Miltra models are entirely inert and free from explosives and are designed to accurately represent the live munitions in size, markings and major recognition features. Many models are designed to allow the known render safe procedure to be carried out. Also available are reactive models using light and sound for use in the classroom and field.

Miltra can also supply technical data including black/white and colour data sheets and books, and is developing digital data on CD-ROM.

All manufacturing production is to BS EN ISO 9002:1994 quality standards.

Status
Available.

Contractor
Miltra Engineering Limited.

Remotec UK Control Training Simulator (CTS)

Description
Remotec UK, in conjunction with Anite Systems, has developed a Control Training Simulator (CTS) for its range of Wheelbarrow remotely operated vehicles (see separate entries) used for EOD.

The simulator is a PC-based virtual-reality training system designed to provide realistic training scenarios such as urban street, two-storey house interior and test track. There is the option to configure the vehicle's camera position, the position and type of improvised explosive device and the position of doors and furniture in the virtual house. Operators are able to train in all aspects of vehicle control using the same operational hand controller as used on the Wheelbarrow. The video images produced by the onboard cameras have been modelled to provide an operator with simulated views of a 3-D virtual world, and the vehicle's electronic systems have been modelled to provide realistic response to control inputs, including negotiating kerbs, staircases and obstructions.

Other features include live-firing and disruption effects and built-in simulated penalties for incorrect operation.

The benefits of the system include decreased training cost, since damage to real vehicles and collateral damage caused by inexperienced operators is reduced. The virtual worlds can be navigated by joystick at any point on a training sortie to enable operators to learn from their mistakes.

The CTS consists of an industrial PC with a graphics processor and hand controller interface electronics. Power supply can be 220–240 or 110 V AC, and the maximum power consumption is 400 W.

Status
No longer in production.

Contractor
Remotec UK.

United States

Training Improvised Explosive Device Increment 2 (T-IED2)

Development
The Training Improvised Explosive Device Increment 2 (T-IED2) was designed to provide a capability for ground troops on recognition and reaction training to real Improvised Explosive Devices (IEDs). The Training IED (T-IED) simulators accurately and safely simulate the capabilities and characteristics of clandestine employment of real IEDs. The Joint IED Defeat Organization (JIEDDO), US Marine Corps, US Army Training and Doctrine Command (TRADOC), US Army Forces Command (FORSCOM) and in-theater combatant commands have participated in the development of the T-IED2 kit.

Description
The components of the T-IED2 kit accurately and safely simulate the capabilities and characteristics of real IEDs by providing a non-pyrotechnic IED signature using CO_2 and talcum powder for the bang and simulated smoke plume effect. The SCoPIS (Self-Contained Portable Improvised Explosive Device (IED) Simulator) device (see separate entry) is the current pyrotechnic solution which uses M30 and M31 cartridges to produce the loud bang and star cluster visual effect.

The T-IED2's Common Interface Device (CID) provides the flexibility to remotely or hardwire initiate currently fielded pyrotechnic devices such as the Main Gun System Simulator (MGSS), Direct Indirect Fire Cue (DIFCUE) and SCoPIS. Additionally, the T-IED2 can be defeated with simulated contemporary electronic counter measures such as CREW1 Trainers (Warlock) and CREW2 Trainers (Duke).

Status
Available. Since program inception in April 2005, more than 12,000 soldiers, marines, sailors and airmen have been trained and over 3,700 training devices have been fielded to more than 70 different installations and schools worldwide.

Contractor
US Army PEO STRI.

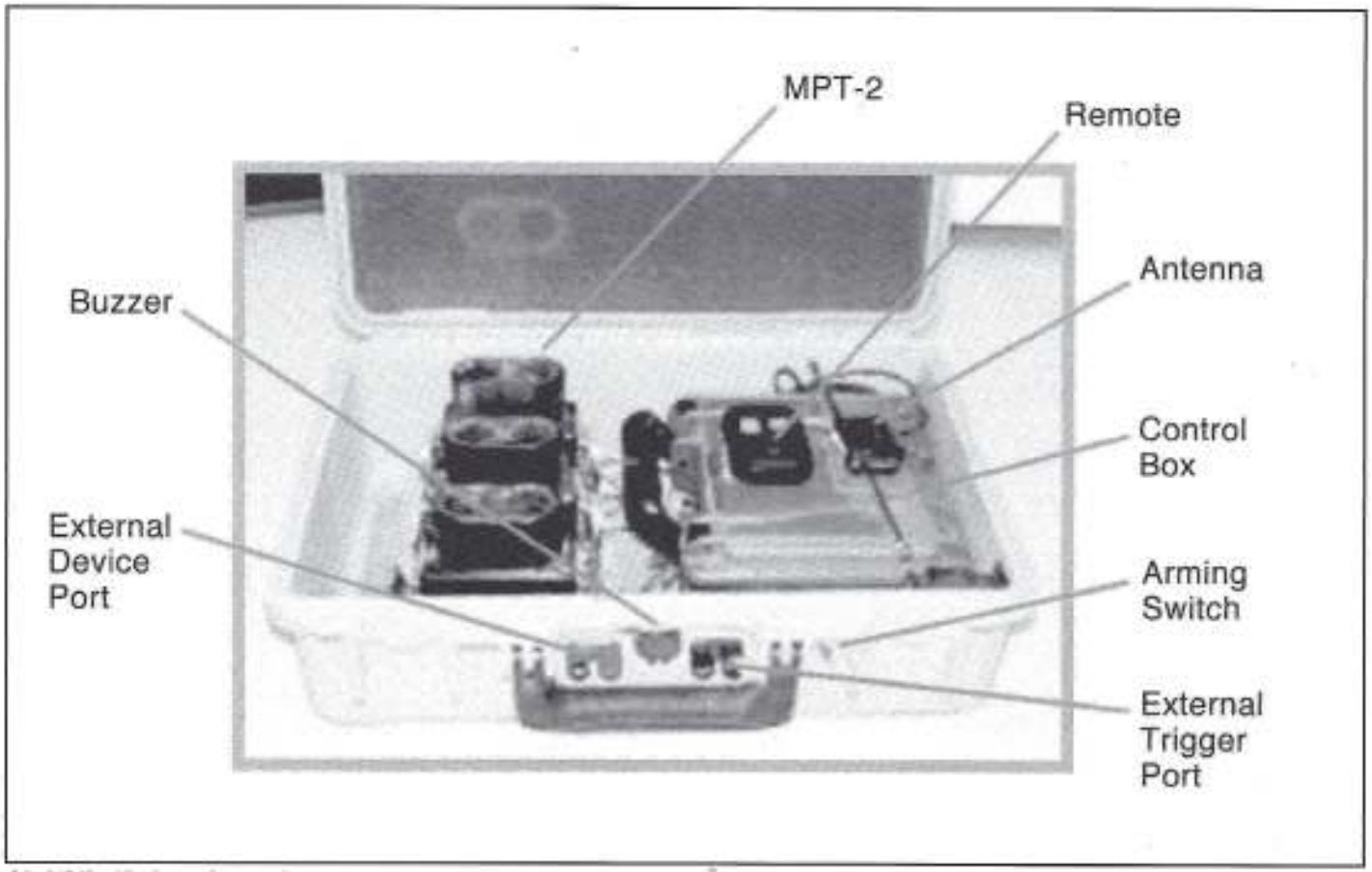
T-IED (US Army) 1334713

SCoPIS (Self Contained Portable Improvised Explosive Device (IED) Simulator)

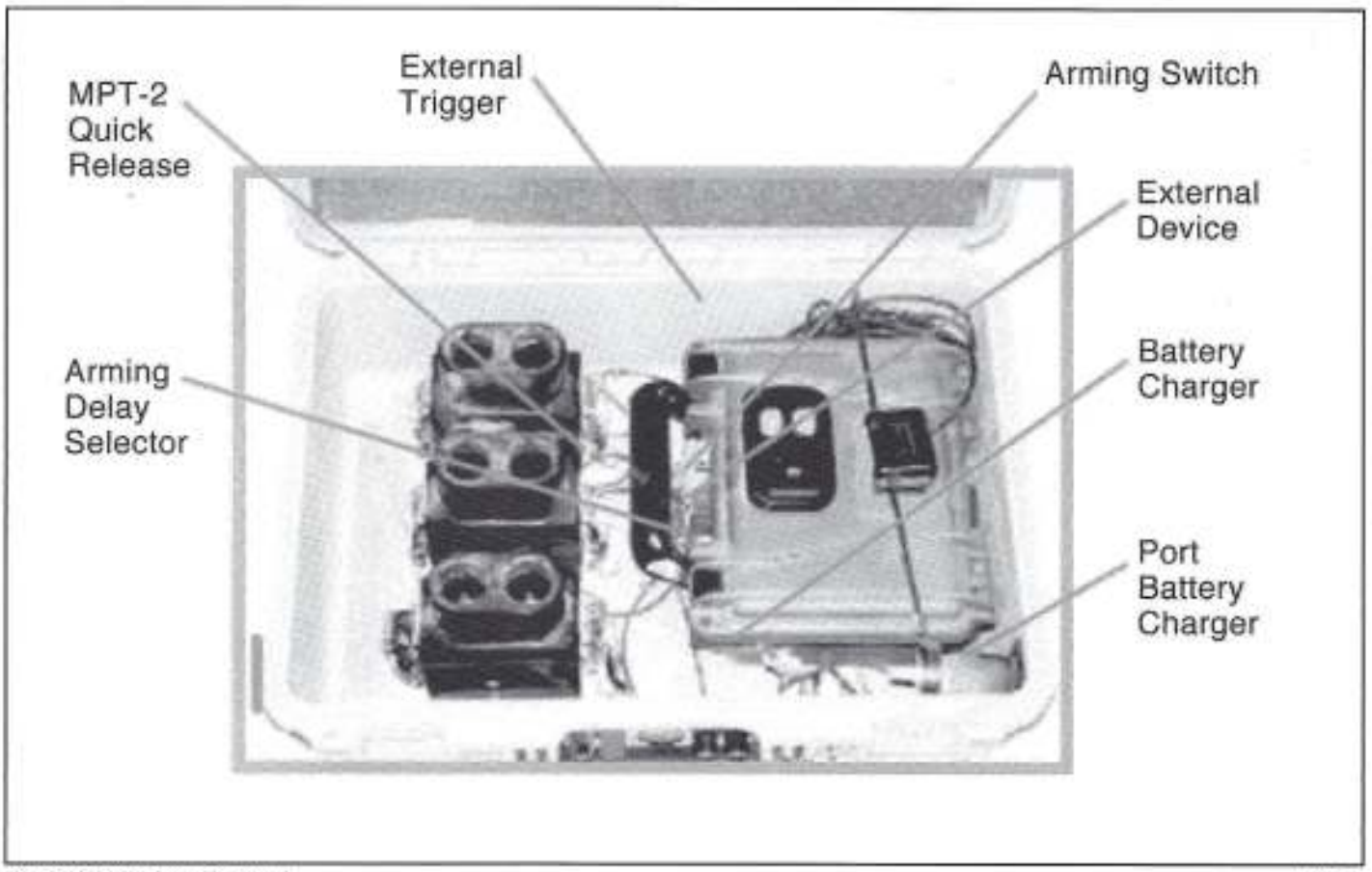
Development
The SCoPIS (Self Contained Portable Improvised Explosive Device (IED) Simulator) was designed to simulate the visual and audible signatures of an Improvised Explosive Device (IED). The SCoPIS was fielded in 2005.

Description
The SCoPIS is lightweight, easy to use and provides military and law enforcement teams with a realistic recognition and simulation of the IED threat being used by terrorists around the world. The SCoPIS simultaneously fires six pyrotechnic cartridges to give an unmistakable audiovisual signature. The simple rugged design makes the device perfect for extended field training and requires little maintenance. Armed with the ability to add external trigger devices as well as add on pyrotechnics, this device provides the trainer with the ability to replicate IEDs, artillery, mortar explosions and large calibre gun fire. The SCoPIS also features the ability to quickly reconfigure the device into a variety of packages, providing additional training enhancement.

The SCoPIS features three Multi Purpose Trainer (MPT-2) firing devices linked to a control unit that features the ability to detonate the simulator using radio control, command wire, motion sensor, photo electric beam and trip wire, as well as through integration with the Multiple Integrated



SCoPIS (Pacific Coast Systems) 1334714



SCoPIS (Pacific Coast Systems) 1334715

Laser Engagement System (MILES). The entire unit is housed in a small weatherproof case. The system has built-in safety features with adjustable delay arming, electromagnetic discharge filters and loose latch features and a built in buzzer to check set up distances. The device also includes the ability to plug in external devices such as smokepots, Smokey Sam rockets, or other SCoPIS devices.

Status
In production. In operation in Germany, Kuwait and US.

Contractor
Pacific Coast Systems LLC.
Raytheon Technical Services Company.

VEHICLES: REMOTE CONTROL
Australia

Echidna EOD robot

Description

The Echidna EOD robot was specifically designed and constructed to meet requirements encountered in EOD and improvised explosive device missions. It is of rugged construction and has a self-righting capability.

The turret unit allows ordnance or other equipment to be rotated through 225°. The unit can lift a mass of 20 kg at a distance of 2 m from the front of the vehicle and traverse with this mass through 180° in either direction. It is these specially developed arms and turret mechanism which give the Echidna its ability to right itself.

An onboard cable reeler automatically dispenses or retrieves up to 110 m of cable. This eliminates snagging or damage to the cable during operations. A 100 m extension is available.

The control system, which includes proportional speed control, makes the Echidna a highly manoeuvrable vehicle. It has the ability to climb and descend a flight of stairs or a ramp having a maximum gradient of 38°. The unit can operate effectively in confined spaces and negotiate right-angled corners in passages or staircases of 900 mm width.

Echidna is operated remotely at a Monitor Control Station incorporating a colour video monitor and displays. The hand control unit can be used for local control when the unit is not engaged in a mission. The monitor station continuously displays information on the turret and driving camera orientation as well as upper and lower arm positions. These features allow the operator to know the precise configuration and orientation of the vehicle at all times.

The vehicle driving camera is carried on the turret but operated independently. Mounted on an individual pan-and-tilt unit, the system provides excellent all-round visibility. A second camera for weapon aiming is usually mounted on the upper arm, but may be positioned on the vehicle chassis.

The vehicle is powered by two 12 V sealed, maintenance-free, recombination-type batteries, providing an endurance of between 6 and 8 hours. The batteries, classified as 'non-spillable', meet all International Air Transport Association requirements.

Echidna has been designed to accept a wide range of accessories. These include twin disruptor mounts, a semi-automatic shotgun in special mount, a wrist joint, and special weapon mounts. A parallel gripper (manipulator) with a jaw opening of 170 mm and ±360° continuous rotation is available, together with a heavy-duty grab. A telescopic arm with a mounting cradle replaces the standard top arm on the Echidna platform and is capable of being extended by 1,500 mm.

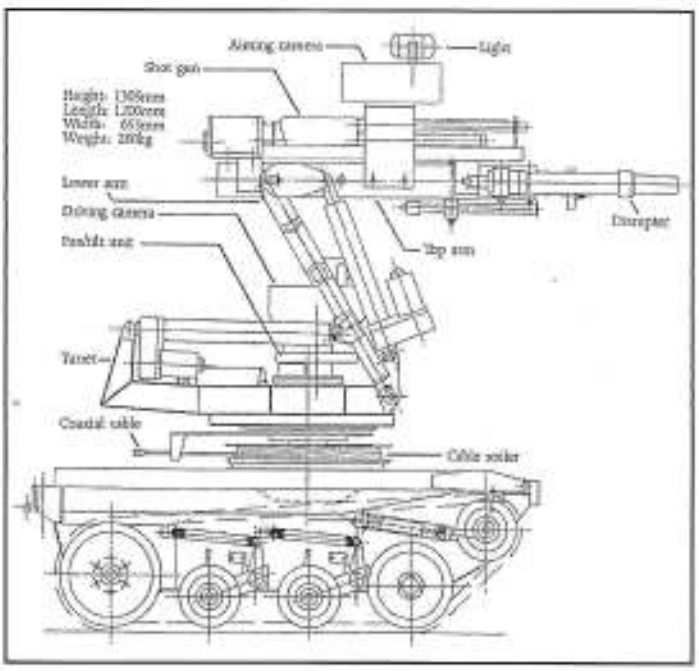
Further accessories include a charge dropper, car towing hook and X-ray equipment mounting frame.

Status

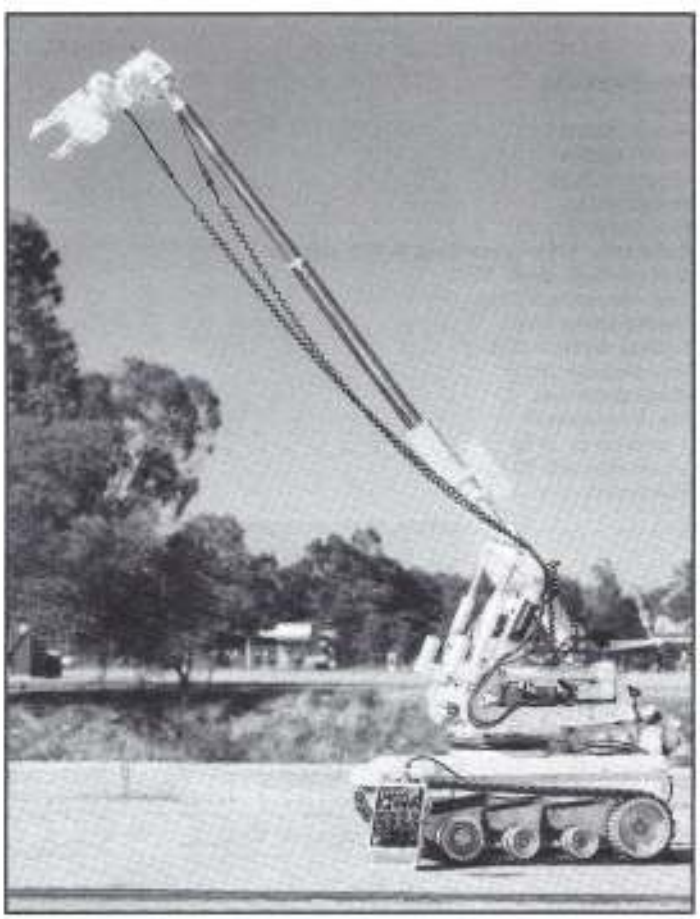
No longer in production.

Contractor

Downer EDI Limited (formerly Evans Deakin Industries Limited).



Layout drawing of Echidna EOD robot 0615798



Echidna EOD robot with telescopic arm fully extended 0615798

Echidna EOD robot with telescopic arm retracted, wrist joint and parallel gripper 0615797

SECTION 4

Ferret

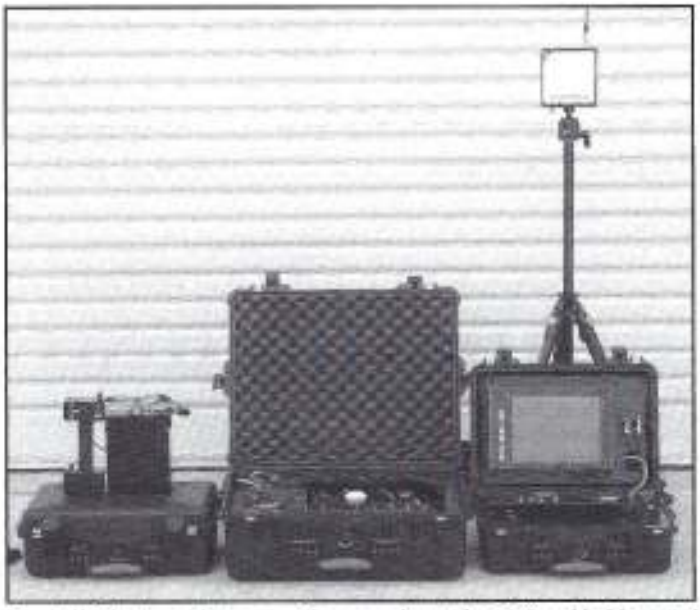
Description
Ferret was designed by Ausrobot and the Australian government's Defence Science and Technology Organisation and is designed to offer operators a low-cost, versatile and highly mobile surveillance capability for use in counter terrorist activities, bomb incidents, vital asset protection, covert or overt route or track observation, hostage and siege situations or other roles where remote inspection, surveillance is required with video.

It is fitted with an auto-focus tilt camera and driving lights. An external replaceable battery allows extended operations. Ferret's small size and mobility allow it to move freely for up to 2 h, up to 800 m from the operator's console. An optional mobile control station is available as an alternative to the larger ground control station (GCS) and consists of head up display and hand control unit.

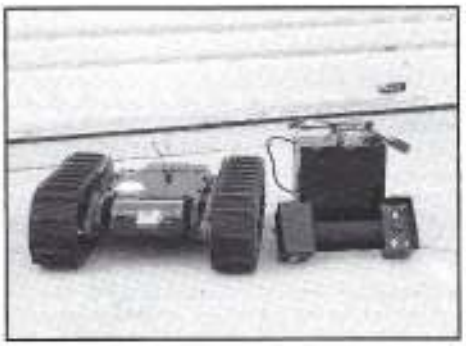
Specifications
Ferret
Height: 0.12 m
Width: 0.38 m
Length: 0.38 m
Weight: 6 kg
Max speed: 4.5 km/h
Endurance: 1–2 h operational, 4 h standby
Max gradient climb: 40°
Curb clearance: 0.10 m
Turning circle: zero
Fording depth: 0.10 m
Max payload: 15 kg
Battery: 12 V lithium polymer
Portable control station size:
(length) 0.42 m
(width) 0.28 m
(depth) 0.16 m
Weight: 7 kg
Range of radio remote control: 300 m
Frequency: 2.4 GHz for video, 900 MHz for control

Status
Development completed. Six in service with the Australian Defence Force.

Contractor
Ausrobot.



Ferret UGV stowed in transporting case (centre) with hand-held control (left) and large GCS (right) (Ausrobot) 1295277



Ferret with hand-held control (Ausrobot) 1295280

Spiker

Description
Spiker is a dedicated counter-improvised explosive device (counter-IED) tracked platform fitted with a three-degrees-of-motion manipulator arm, Richmond RE 70 disruptor and a second universal shaped charge holder.

The RE 70 is recoilless and can be configured either as a de-armer for firing a range of solid projectiles or a disruptor for firing a range of fluid and frangible projectiles. It is fitted with targeting lasers either side of the barrel and a top-mounted x22 optical camera. Additionally a boresight camera is attached to the pan-tilt mechanism on the mast and a light is fixed alongside the boresight camera for illumination.

The manipulator arm can be moved along its base fixing before being locked in place and there is title at the base of the arm and a pan rotation on the arm's wrist.

There are two DC motor/gearbox combinations for the platform: 4 x 40W DC motor with either 100:1, 264:1, 512:1 gearbox (wheels/tracks) or 2 x 150 W DC motor (fixed track system, in development).

Specifications
Spiker
Height: 0.60 m
Width: 0.36 m
Length: 0.75 m
Weight: 30 kg
Max speed: 5 km/h
Endurance: 1–2 h operational, 8–10 h standby
Max gradient climb: 35°
Curb clearance: 0.20 m
Turning circle: Zero
Fording depth: 0.20 m
Max payload: 25 kg
Manipulator arm
Max lift capacity:
(extended): 15 kg
(unextended): 30 kg
Max length: 1 m

Ausrobot Spiker counter-IED robot (Ausrobot) 1295283

Ausrobot Spiker was developed by the Australian government's Defence Science and Technology Organisation (DSTO) 1295291

Battery: Two Ultralife/Milpower BB-2590 15 V lithium ion batteries
Portable control station:
(length) 0.45 m
(width) 0.56 m
(depth) 0.30 m
Weight: 8 kg
Range of radio remote control: 500 m
Frequency: 2.4 GHz video feed from platform, 900 MHz for command and control

Status
Research and development ongoing.

Contractor
Ausrobot.

Canada

Mk 1 CALIBER® Scout Robot

Development
The Mk 1 – CALIBER® Scout Robot is an entry-level robotic platform ideal for tactical/surveillance/monitoring tasks.

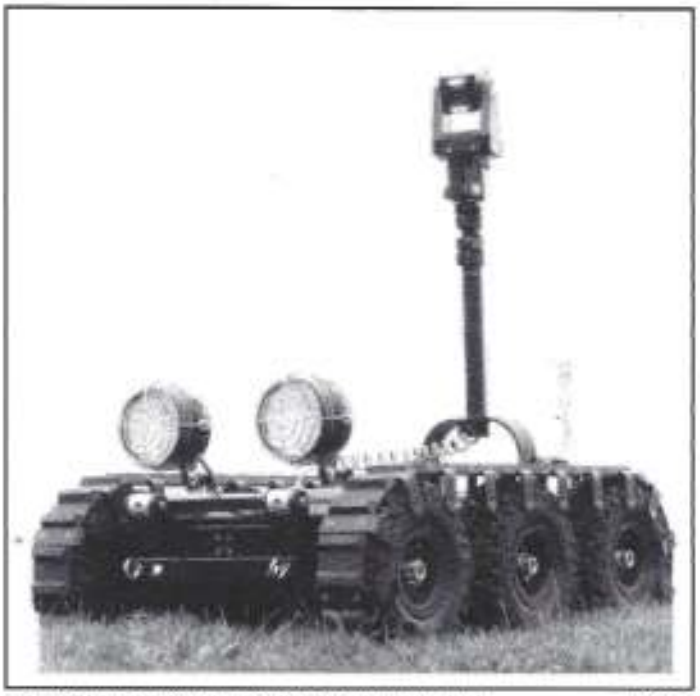
Description
The Mk 1 – CALIBER® Scout Robot is the first of three in the CALIBER® family of robots. It has three cameras, 2-way audio and the ability to climb stairs, making it ideal for tactical and surveillance situations. SWAT teams can use the robot for clearing houses and gaining intelligence before entry.

The Mk 1 – CALIBER® Scout Robot is designed with modular components so that it can be built upon in a successive manner, allowing upgrades to the Mk 2 CALIBER® Tactical or Mk 3 – CALIBER® EOD (see separate entries).

On either side of the platform there are two aluminium rack mount channels for carrying miscellaneous tools such as search lights, tools and other EOD equipment. If required, ICOR can customise an appropriate mount to fit.

The Mk 1 CALIBER® Scout Robot is easily controlled with the variable speed joystick on the hand-held Command & Control Unit (CCU).

Specifications
Length: 84 cm
Width: 62 cm
Stowed height: 56 cm
Weight: 64 kg
Ground clearance: 5.7 cm
Battery pack: 24 V DC quick-change pack, (two 12 V, 13 A/h battery
Configuration: 6 × 6 all-wheel drive with 2-speed transmission
Speed:
(low gear) 0–3.2 km/h
(high gear) 0–8 km/h
Wheels: Pneumatic tyres with quick release (tyre size: 10.0 in/25.0 cm). Two wheels can disengage from drive system
Drag capacity: 113 kg



Mk 1 CALIBER® Scout robot (ICOR Technology Inc) 1299266

Status
Available.

Contractor
ICOR Technology Inc.

Mk 2 CALIBER® – Tactical Robot

Development
The Mk 2- CALIBER® Tactical Robot was designed specifically for EOD/IED render safe procedures.

Description
The Mk 2 – CALIBER® Tactical Robot is the second of three in the CALIBER® family of robots (see separate entries). It is a fast, lightweight, bomb disposal robot that features one robotic arm with a rotating and tilting tactical turret providing the capability of aiming two recoilless disrupters at a suspect package.

The Mk 2 – CALIBER® Tactical Robot is capable of firing two recoilless disrupters and can integrate with almost all major recoilless disrupter models currently available. The 355° rotating and 180° tilting tactical turret is equipped with two standard independent firing circuits, two colour cameras, two LED lights and warning LED indicators.

On either side of the platform there are two aluminium rack mount channels for carrying miscellaneous tools such as search lights, tools and other EOD equipment. If required, ICOR can customise an appropriate mount to fit.

The Mk 2 CALIBER® robot is easily controlled with the variable speed joystick on the hand-held Command & Control Unit (CCU).

Specifications
Length: 84 cm
Width: 62 cm
Stowed height: 56 cm
Weight: 73 kg
Ground clearance: 5.7 cm
Max reach: 167.6 cm
Battery pack: 24 V DC quick-change pack, (two 12 V, 13 A/h battery
Configuration: 6 × 6 all-wheel drive with 2-speed transmission

Mk 2 CALIBER® Tactical Robot (ICOR Technology Inc) 1299267

Speed:
(low gear) 0–3.2 km/h
(high gear) 0–8 km/h
Wheels: Pneumatic tyres with quick release (tyre size: 10.0 in/25.0 cm). Two wheels can disengage from drive system
Drag capacity: 113 kg

Status
Available.

Contractor
ICOR Technology Inc.

Mk 3 – CALIBER® EOD Robot

Development
The Mk 3 – CALIBER® EOD robot was designed for squads requiring a robotic capability for either EOD or SWAT missions.

Description
As a medium-sized robot, the Mk 3 – CALIBER® combines the towing and dragging capability of larger platforms, but with the speed and stair climbing ability of smaller, lightweight platforms.

The Mk 3 – CALIBER® is the third of three design models (see separate entries). It is a two armed, multi-functional robot, combining a heavy duty robotic claw and twin-disrupter/weapons turret. Two robotic arms allow users to lift heavier payloads with the claw without sacrificing the aiming capability of the disrupters. Surveillance missions are easily accomplished with any of the 6 colour cameras fitted onboard the robot.

The Mk 3 – CALIBER® EOD robot is capable of firing two recoilless disrupters and can integrate with almost all major recoilless disrupter models currently available. The 355° rotating and 180° tilting tactical turret is equipped with two standard independent firing circuits, two colour cameras, two LED lights and warning LED indicators.

The telescoping arm and robotic claw on the robot is controlled independently of the tactical arm and can lift 65 lbs. Pre-drilled attachment holes on the claw are spaced one inch apart, allowing a technician to fasten EOD tools, for example, hooks, cutters and window punches.

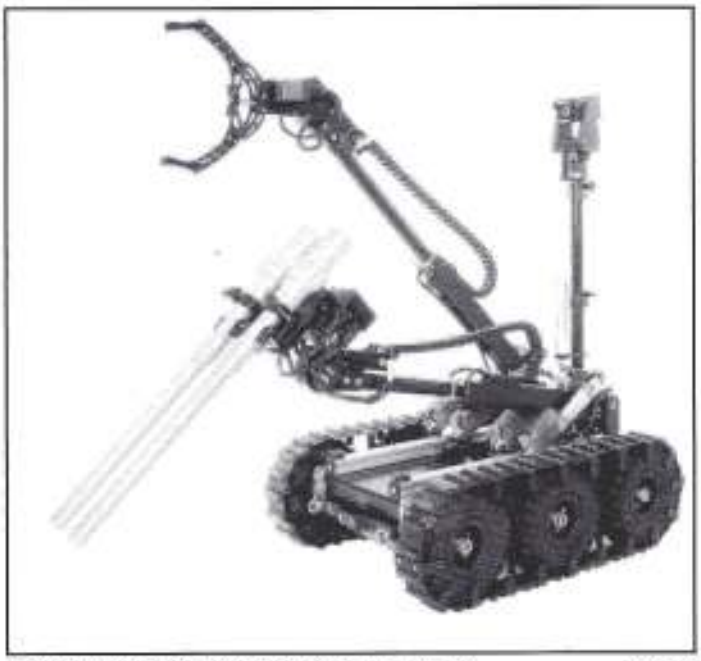
On either side of the platform there are two aluminium rack mount channels for carrying miscellaneous tools such as search lights, tools and other EOD equipment. If required, ICOR can customise an appropriate mount to fit.

The Mk 3 CALIBER® robot is easily controlled with the variable speed joystick on the hand-held Command & Control Unit (CCU).

Specifications
Length: 84 cm
Width: 62 cm
Stowed height: 56 cm
Weight: 88 kg
Ground clearance: 5.7 cm
Max reach: 167.6 cm
Battery pack: 24 V DC quick-change pack, (two 12 V, 13 A/h battery)
Configuration: 6 × 6 all-wheel drive with 2-speed transmission
Speed:
(low gear) 0–3.2 km/h
(high gear) 0–8 km/h
Wheels: Pneumatic tyres with quick release (tyre size: 10.0 in/25.0 cm). Two wheels can disengage from drive system
Drag capacity: 113 kg

Status
In service and available. Customers include security forces and EOD teams in Canada, China, Egypt, India and US.

Contractor
ICOR Technology Inc.



Mk 3 CALIBER® EOD robot (ICOR Technology Inc) 1289268

Mk 3 CALIBER EOD robot (ICOR Technology Inc) 1295307

Remote Mobile Investigator RMI-10

Description
The RMI-10 is a compact and lightweight battery operated multi-purpose vehicle designed for the remote handling of improvised explosive devices (IEDs), hazardous chemicals, radio active materials, fire fighting, hostage situations, hijackings and other hazardous situations.

It is lightweight for easy deployment and has a narrower design, compared to other platforms in the family, for use in confined spaces and has 4-drive wheels which provide increased stability.

The RMI-10 is equipped with three colour cameras, a main panning camera with stop dead center, and a miniature remote tilting camera for car and building searches with the images fed back to a colour monitor.

Two way communication is available which can be utilised in various situations including hijackings or hostage takings.

The optional universal claw has variable pressure (9–27 kg) which allows it to pick up an object without damaging it (soft touch) or with added pressure so it can grip heavy objects.

The platform can be equipped with seven arm extenders for hard to reach locations such as under cars, in cars and window sills. A mechanical claw, miniature tilting camera or a five shot semi-automatic shotgun with laser aiming can be attached to the end of the arm extender. One disruptor can be fitted to the front arm and remotely fired with laser aiming.

All functions can be controlled either through a lightweight heavy duty control cable or by radio control.

Specifications
RMI-10
Height: 0.51 m
Width: 0.56 m
Length: 0.86 m
Weight: 64 kg
Max speed: 3 km/h
Endurance: 2 h
Max gradient climb: 40°
Curb clearance: 12 cm
Turning circle: 1 m
Fording depth: 10 cm
Max payload capacity: 100 kg

Manipulator arm
Max lift capacity:
(extended) 16 kg
(unextended) 34 kg
Max length: 0.83 m
Portable control station:
(length) 61 cm
(width) 28 cm
(depth) 46 cm
Weight: 15 kg
Control link: Cable or remote control
Line of sight control: 800 m

Status
In service with Canadian Police Department, military and emergency services. Also being exported worldwide. Deliveries are continuing.

Contractor
Pedsco.

The Pedsco RMI-10
(Pedsco)
1296300

RMI-9WT

Description
The RMI-9WT is a remote investigating robot used by police, fire departments, military, nuclear and industrial institutions worldwide.

It is a compact and lightweight battery-operated multi-purpose vehicle that has proven to be ideal for the remote handling of improvised explosive devices (IEDs), hazardous chemicals, radioactive materials, fire fighting, hostage situations, hijackings and other hazardous situations.

The RMI-9WT is versatile with 10 drive wheels to handle rugged terrain or with 6 drive wheels with tracks for extra climbing capability.

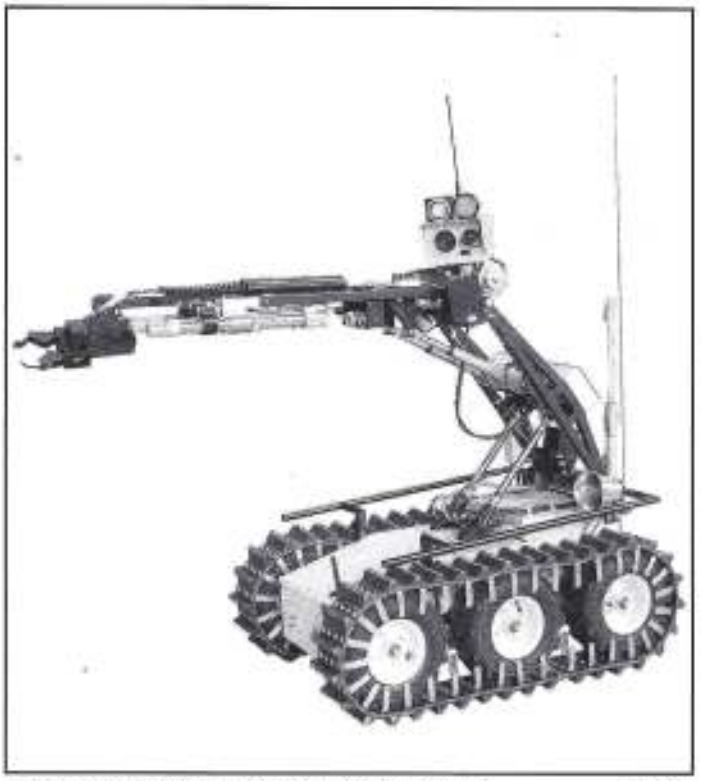
It is equipped with three colour cameras with the main camera having remote-panning with dead center stop, and a miniature remote tilting camera, for car searches and so on, with the imaging transmitted to a colour monitor.

The universal claw has variable pressure (9 to 27 kg) which allows it to pick up an object without damaging it (soft touch) or with added pressure so it can grip heavy objects.

The platform can be equipped with a motorised extension arm and three arm extenders for hard to reach locations such as under cars, in cars and window sills. The mechanical claw, miniature tilting camera or disrupter can be attached to the end of the arm extender.

Additional options for the robot include a five shot semi-automatic shotgun with laser aiming, two-way communication which can be used for hostage or hijacking situations and a x-ray attachment can be fitted, suitable for the XR200/150 x-ray unit. Furthermore, two disruptors can be fitted to the front arm and remotely fired with laser aiming.

The control box operates all functions of the RMI-9WT, either through a lightweight heavy duty control cable or by radio control. Precise movement of the RMI-9WT can be mastered quickly using the joystick drive controls. The firing controls send coded signals for greater security.



The Remote Mobile Investigator RMI-9WT (Pedsco) 1295299

Specifications
RMI-9WT
Height: 0.82 m
Width: 0.68 m
Length: 1.17 m
Weight: 178 kg
Max speed: 3 km/h
Endurance: 8 hours
Max gradient climb: 45°
Curb clearance: 26 cm
Turning circle: 1.37 m
Fording depth: 14 cm
Max total payload: 200 kg
Manipulator arm
Max lift capacity:
(extended) 41 kg
(unextended) 81 kg
Max length: 1.12 m
Portable control station:
(length) 61 cm
(width) 28 cm
(depth) 46 cm
Weight: 15 kg
Control link: Cable or radio control
Line of sight control: 800 m

Status
In service with Canadian Police Department, military, and emergency services. Also being exported worldwide. Deliveries are continuing.

Contractor
Pedsco.

For details of the latest updates to *Jane's Explosive Ordnance Disposal* online and to discover the additional information available exclusively to online subscribers please visit **jeod.janes.com**

France

Cameleon

Description
Cameleon is a tracked, medium multi-purpose vehicle which can be used for counter-improvised explosive device, explosive ordnance disposal, route clearance, reconnaissance, first response, survey, mapping and hazardous materials operations.

Manipulator arm attachments include a gripper colour camera with ×40 zoom, turret with colour day/night camera with ×4 zoom, disruptor camera with lighting and chemical and radiological detector. Other payloads tested with the platform include navigation module, sound detection, panoramic camera, telescoping pan and tilt, smoke dispenser, tear gas launcher and dropping arm mechanism.

As well as radio control up to 500 m, Cameleon is also equipped with 200 m of fibre optic cable which is supported by an automatic wind and rewind cable wheel and end of cable detection. GPS/inertial navigation system is optional.

The control station is operated with a 26.4 cm touchscreen and two joysticks.

The manipulator arm has six electrical axis; the standard arm gripper has a 360° rotation and an aperture of 9 cm.

Cameleon has a maximum payload capacity of 20 kg (ECA) 1295301

Specifications
Cameleon
Height: 0.19 m
Width: 0.50 m
Length: 0.67 m
Weight: 25 kg
Max speed: 6.12 km/h
Endurance: 2.5 h
Max gradient climb: 35°
Curb clearance: 0.25 m
Turning circle: Zero
Max payload: 20 kg
Battery: Lithium ion, 32 V
Manipulator arm
Max lift capacity:
(extended) 3 kg
(unextended) 8 kg
Max length: 1.5 m
Weight: 15 kg (without accessories)
Portable control station:
(length) 0.23 m
(width) 0.40 m
(depth) 0.65 m
Weight: 3.2 kg
Range of radio remote control: 500 m
Frequency: 2.4 GHz

Status
In service, deliveries continuing. Fifty ordered, 10 delivered.

Contractor
ECA.

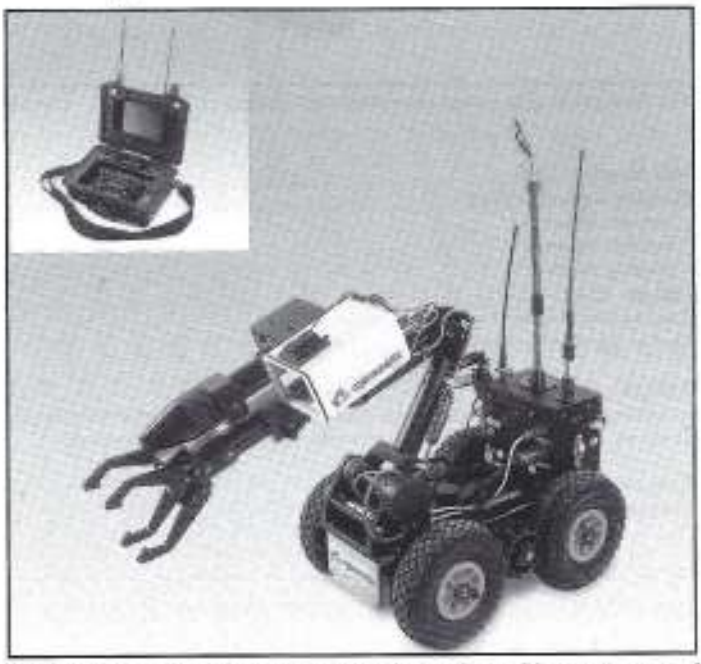
Castor mobile intervention robot

Description
Castor is a small, tele-operated mobile robot (cable and radio) designed to carry out remote-controlled inspection and intervention operations in hostile environments in complete safety for the operator. It is suited to handling and neutralising explosives as well as operations in nuclear, biological or chemical (NBC) environments.

The vehicle can be easily transported in a car or by helicopter. The battery pack can be replaced in under 10 seconds enabling continuous operation, while its small size allows it to operate easily in difficult to access areas such as trains, buses and aircraft aisles.

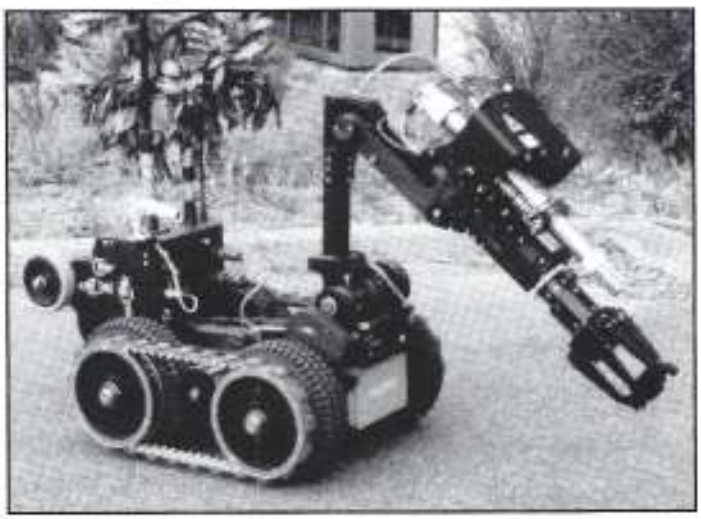
Castor is equipped with a manipulator arm mounted with a remotely controlled grip. It features an auto-focus colour zoom (×12) camera on the arm, an auto-focus colour driving camera and a 20 W halogen headlight. It can also be supplied with various accessories, including disruptors, pyrotechnic charges, laser sight within disruptor axis, distance sensor (telemeter) and NBC instrumentation.

The system can also be supplied with larger wheels, allowing greater obstacle clearance and suitability for use on more severe gradients. Another option is for a pan and tilt CCD video camera, auto-focus with zoom at ×15.



Castor miniature mobile intervention robot and portable remote-control case (Cybernetix) 0528218

Specifications
Max speed: 1 m/s
Weight (without armament): 47 kg
Wheel diameter: 0.26 m
Dimensions with arm retracted
length: 0.73 m
width: 0.4 m
height: 0.52 m
Power supply: 28.8 V Ni/Cd battery
Intervention length: 0.88 m
Max arm load
extended: 5 kg
retracted: 10 kg



Castor with belt-driven wheels (Cybernetix) 0567418

Grip
aperture: 250 mm
strength: 30 daN
rotation: 360° continuous
Joint limits
arm: –90/+120°
forearm: –45/+180°
wrist (manual): ±30°
Range
radio (unobstructed space): 300 m
cable: 125 m

Max slope: 25°
Max tilt: 25°
Obstacle clearance: 150 mm
Min half-turn length: 760 mm

Status
In production and in service in China, France and Kazakstan. No longer being marketed.

Contractor
Cybernetix.

Cobra

Description
ECA's Cobra is a small EOD neutralising and reconnaissance vehicle dedicated to disruptor use and object inspection, particularly in an urban environment. With large wheels and a wide base it is capable of operating at a tilt of 40° or on an equal slope. The platform is designed as light and shock resistant to support operational scenarios where it needs to be thrown into buildings and is reversible.

As well as a microphone, which links to a loudspeaker on the control unit, there is a front camera (charge coupled device (CCD), ×3 zoom) mounted on an a –80°/+80° tilt actuator and a rear camera (CCD wide angle, 68° horizontal, 54° vertical).

Proparms recoil absorbing mechanism, designed to hold the Neutrex 12.5 mm disruptor, has been installed on the platform as well as an Aquaset disruptor holder.

It can operate in temperatures ranging from –10°C/+55°C. The control station is housed in a brief case and has a 14 cm display.

Cobra is rugged throw-able reconnaissance and disruptor platform (ECA) 1295303

Specifications
Cobra
Height: 0.17 m
Width: 0.39 m
Length: 0.36 m
Weight: 5.6 kg
Max speed: 7.5 km/h
Endurance: 2 h
Max gradient climb: 35°
Curb clearance: 0.09 m
Turning circle: 0.30 m
Max payload: 4 kg
Battery: Nickel-metal hydride battery, 12 V
Range of radio remote control: 130 m line-of-sight
Frequency: 2.4 GHz

Range (cable): 200 m
Portable control station:
(length): 0.40 m
(width): 0.33
(depth): 0.17 m
Weight: 5 kg

Status
In service, deliveries continuing. 10 on order, 20 delivered.

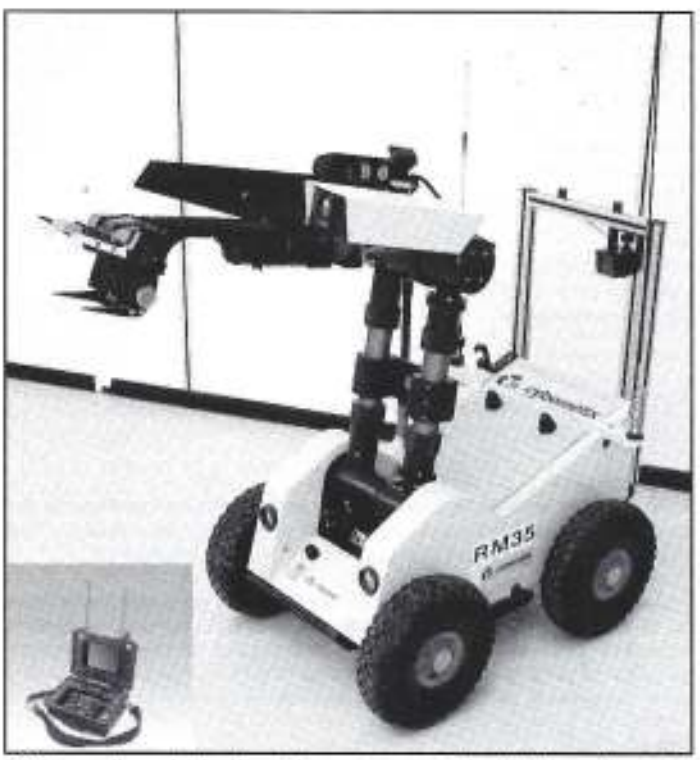
Contractor
ECA.

RM35 mobile intervention robot

Description
The RM35, a larger version of the Castor mobile intervention robot (see separate entry), is a tele-operated mobile robot (cable and radio) designed to carry out remote-controlled inspection and intervention operations in hostile environments in complete safety for the operator. It is suited to handling and neutralising explosives, where necessary within nuclear, biological or chemical (NBC) environments.

The vehicle can be easily transported in a car or by helicopter. The battery pack can be replaced in under 10 seconds enabling continuous operation, while its size allows it to operate easily in towns, airports and difficult access areas such as trains or buses.

The RM35 is equipped with a manipulator arm mounted with a remotely-controlled grip and an auto-focus colour zoom (×12) camera. Illumination is provided by one 20 W and two 5 W halogen spotlights. It can be supplied with various accessories, including disruptors, pyrotechnic charges, laser sight, distance sensor (telemeter) and NBC instrumentation. Optional alternative equipment includes a pan and tilt camera (colour and zoom ×15, auto-focus).



RM35 medium-sized wheeled remote-operated vehicle and portable remote control case (Cybernetix) 0528220

Specifications
Maximum speed: 0.75 m/s
Weight (without armament): 75 kg
Wheel diameter: 0.3 m
Dimensions with arm retracted
length: 0.84 m
width: 0.59 m
height: 0.68 m
Power supply: 24 V Ni/Cd battery
Intervention length: 1.45 m
Maximum arm load
extended: 5 kg
retracted: 15 kg
Grip
aperture: 250 mm
strength: 30 daN
rotation: 360° continuous

Joint limits
arm: –60/+120°
forearm: –30/+180°

SECTION 4

Range
radio (unobstructed space): 300 m
cable: 180 m
Maximum slope: 25°
Maximum tilt: 30°
Obstacle clearance: 200 mm
Minimum half-turn length: 0.92 m

Status
No longer in production.

Contractor
Cybernetix.

Germany

KNIGHT Explosive & Ordnance EOD Robot

Development
The KNIGHT can be used for applications in the police, military, Emergency Response Teams (ERT), Fire, Nuclear, and so on. The KNIGHT can also be used for surveillance, reconnaissance, handling of hazardous items, manipulation of suspected packages, neutralizing and handling items such as Improvised Explosive Devices (IEDs), Hazardous Chemicals, and Radioactive Materials. KNIGHT is an all-weather all-terrain mobile robot for indoor (buildings, public institutions, airports, homes, and so on) and outdoor environments (terrain cluttered with obstacles, ditches, gravel, snow, mud).

Description
KNIGHT is of medium-size and equipped with 6 wheels, a set of removable tracks, and a set of removable articulated wheels. The tracks are used for rough terrain and stair or slope climbing. The articulated wheels are used for climbing high obstacles and high slope stairs. The robot is able to turn on-the-spot and manoeuvre precisely in an obstacle-cluttered area. The drives also feature a drive-hub, which can disconnect the drive from the wheels to facilitate manhandling of the robot if necessary. The wheel/track system is reliable for rough terrain. KNIGHT is remotely controlled via a wireless radio link and consists of a robust platform, a dexterous robot arm, operator control station, communication links, and a variety of operational tools and accessories. KNIGHT has a number of special features including quick-removable tracks, quick-removable articulated wheels in front and back for better stability on stairs and slopes. Up to four cameras can be mounted, the surveillance camera on the arm or on an articulated boom.

The arm can be configured to perform operations such as aiming and firing disruptors, pushing heavy payloads, reaching under cars or through car windows, breaking windows and so on. The robot can insert a car key to open car doors, manipulate sensory devices for inspection and surveillance and handle delicate or hazardous materials. A force-controlled high quality gripper provides dexterous handling capability. Various grippers can be attached.

KNIGHT is water resistant and all exposed surfaces are covered with anodizing or protective paint. All detector and electronics compartments are protected against water and contaminants. The robot operates in all types of weather conditions, day and night, and various types of wet and dry surfaces.

Specifications
Length: 127 cm
Width: 70 cm
Height: 79 cm
Weight:
(standard) 250 kg
(with accessories) 300 kg
Manoeuvrability: 360°

KNIGHT Explosive & Ordnance Disposal Robot (Force Ware GmbH) 1344073

Speed: 0 to 2 km/h
Operating time: 3 to 5 h
Lift capacity:
(arm fully extended): 25 kg
(above edge of platform): 120 kg
Operating temperature: –20 to +45°C
Storage temperature: 0 to 45°C
Camera
Arm camera: Colour, wide-angle lens, auto iris
Surveillance camera: Colour CCD, remote zoom (72:1), remote focus, auto iris
(pan/tilt): ±170
Drive camera: Colour, wide-angle lens, auto iris
Cable reel: 200 m

Status
In production.

Contractor
Force Ware GmbH.

SON Small Observation and Neutralisation vehicle

Development
This remotely controlled, small vehicle serves as a tool to observe and disarm suspicious and possibly explosive objects. It is ideal for situations that do not permit the use of larger neutralisation manipulators.

Its small size makes it suitable for tasks in trains, aircraft, ships, offices and other such premises and it is low enough to go under many types of cars. The vehicle is equipped with a sophisticated sensor system, wireless audio and video transmitters to assist in orientation. The system can also be used as a tool for covert observation and can fire alternative ammunition such as flash grenades and smoke shells.

Description
The vehicle has a six-wheel drive, with separate motors for the right and left sides. Each set of three wheels on each side is driven independently, making the vehicle exceptionally manoeuvrable. The wheel size allows it to scale a step of moderate height.

On top of the plastic polymer-coated steel body sits a platform that holds cameras and weapons. It can be tilted by 25° to provide a better view or a more precise aim. The standard equipment consists of three highly sensitive

Kappa SON locating a terrorist device beneath a car (Kappa) 0516334

monochrome cameras directed forward, backward and upward with a 80° viewing angle. These give the operator full command of the vehicle and the upward-looking camera allows the underside of vehicles to be closely examined. It is also possible to install a fourth camera on existing brackets on lower or higher vantage points than the other cameras to provide a better view. This fourth camera could also be a Kappa 3-D stereoscopic camera, which can create a three-dimensional image on a special monitor.

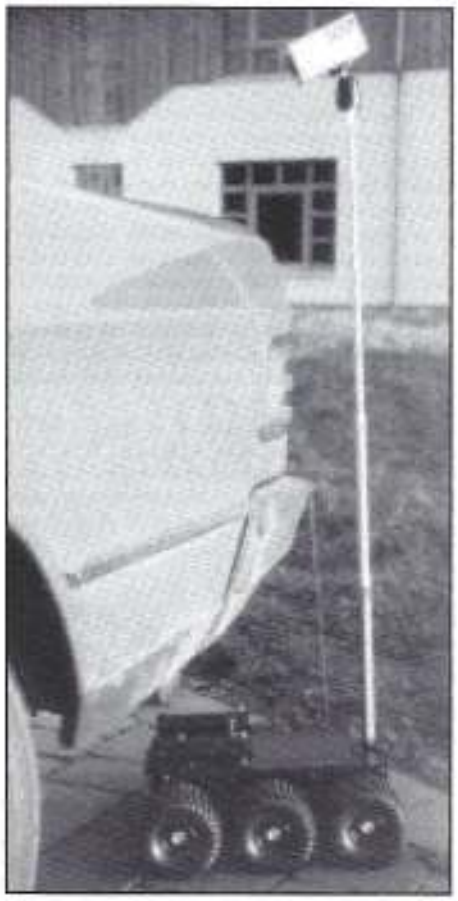
Next to the front camera is a unidirectional microphone which provides the operator with additional acoustic information. For operations under difficult lighting conditions, the three standard cameras are equipped with infra-red LED lights. These are invisible to the human eye so that the vehicle can operate inconspicuously at night and use very little electricity, allowing it to work for an extended time.

The vehicle has two standard firing mechanisms for disposable disruptors which can be discharged independently from each other by remote control. Each disruptor has a laser pointer to ensure accuracy. Both disruptors and pointers sit on a tiltable platform. A multilevel safety system prevents accidental discharge. Additional tools available include a geiger counter, gas detector, and front-mounted fork lift.

The vehicle can be controlled with a computer remote control with PCM (Phase Change Memory) technology. It contains a failsafe-logic for the discharge of disruptors. A transmitter sends the video and audio signals at a frequency of 2.4 GHz. The complete system can draw energy from batteries which can power the vehicle for up to 1.5 hours (depending on type of terrain).

Specifications

Configuration: 6-wheel drive
Dimensions: 390 (incl. firing unit)/420 (with double capacity battery pack) × 330 × 170 mm
Weight: 9.5 kg incl batteries
Power supply: Ni/Cd cells
Driving time: max 1.5 h (depending upon terrain)
Operating time: max 3 h use of camera and transmitter only
Transmitter: audio and video; frequency 2.4 GHz. Max working range 500 m
Nato stock number: 5999-01-493-3185
Disruptors: fittings for two disposable disruptors, two read laser pointers (level of protection II)



SON with camera on the telescopic mount (Kappa)
1298770

Status

In production. In service in China, France, Germany and Russia.

Contractor

Kappa opto-electronics GmbH.

teleMAX EOD robot

Development

The teleMAX EOD robot is designed to provide EOD capabilities in confined spaces and make sure that the vital distance is maintained between the bomb disposal engineer and the bomb, for example, on planes, underground trains and coaches.

Description

The robot features four independently controllable caterpillar tracks that are separately suspended and spring-mounted; they can be elevated to raise the body off the ground, and can also be elevated or lowered together or independently to aid the vehicle in ascending and descending objects, slopes, and staircases etc. teleMAX is able to transit over gradients of up to 45°, climb over obstacles up to 50 cm high, and cross ditches or gaps up to 1.5 m wide. An intelligent control system adapts the tracks and running gear to best match the given situation. This is further aided by a sensor suite that helps maintain the robot's equilibrium. The robot has a top speed of 3.7 km/h when in tracked formation. With the addition of wheels to the drive axles this is increased to 4.7 km/h.

The manipulator has seven degrees of freedom and a telescopic upper arm; it has a rotating base and turret. The maximum reach of the manipulator is 235 cm vertically and 120 cm horizontally. When the base unit is raised these increase to 260 cm and 160 cm respectively; its gripper has a maximum lifting capacity of 5 kg.

Control is via a laptop-style console that features a 26 cm touch screen monitor that has a picture-in-picture function to allow multiple viewing perspectives. Vehicle and manipulator movement is controlled by a thumb and finger joystick unit. The console and transmitter/receiver units are stored in robust cases.

A disruptor is primarily used for EOD purposes, but the manipulator can be equipped with a variety of tools, for example a shotgun. The robot has an on-board magazine that can store two attachments with can be automatically interchanged.

Additional features include self-diagnostic (which can be conducted remotely via the internet) and status testing systems.

Specifications

Width: 40 cm (stowed position)
Length: 80 cm (stowed position), 160 cm (extended position)
Height: 75 cm (stowed position)
Power system: 24 V DC, NiMh battery
Operating temperatures: –20 to +50°C

teleMAX EOD robot (Rheinmetall AG)
1173304

Status

Available and in service.

Contractor

telerob Gesellschaft für Fernhantierungstechnik mbH.

tEODor remote-controlled manipulator vehicle and training system

Description

The telerob Explosive Ordnance Disposal and observation robot (tEODor) is a remote-controlled bomb disposal system. A wide array of standard equipment can be used with the basic model, universal interfaces mounting standard ballistic systems and 40 tools and devices can be operated from tEODor. A tool magazine for three additional EOD devices is provided and the robot allows the parallel operation of up to five ballistic systems, with a maximum of 10 individual rounds. Systems that can be used with tEODor include AQUASET, TEL220, the Remington 11-87 shotgun, DYNERGIT, TELEMACH, drills, grinders, laser aiming devices, window breakers and various camera systems.

An integrated diagnostics system comes with the remote maintenance module and the robot can operate under ambient temperature conditions ranging from –20°C to +60°C.

Also developed by telerob is the CD-ROM-based tEODor interactive training and simulation software. This introduces operators to the control functions and applications of the vehicle. By working with this programme, trainees can become familiar with the system and its usage step by step. The various chapters of the programme include numerous pictures.

The tEODor training system can be used to train users on all aspects of the vehicle (telerob)
0077641

Specifications

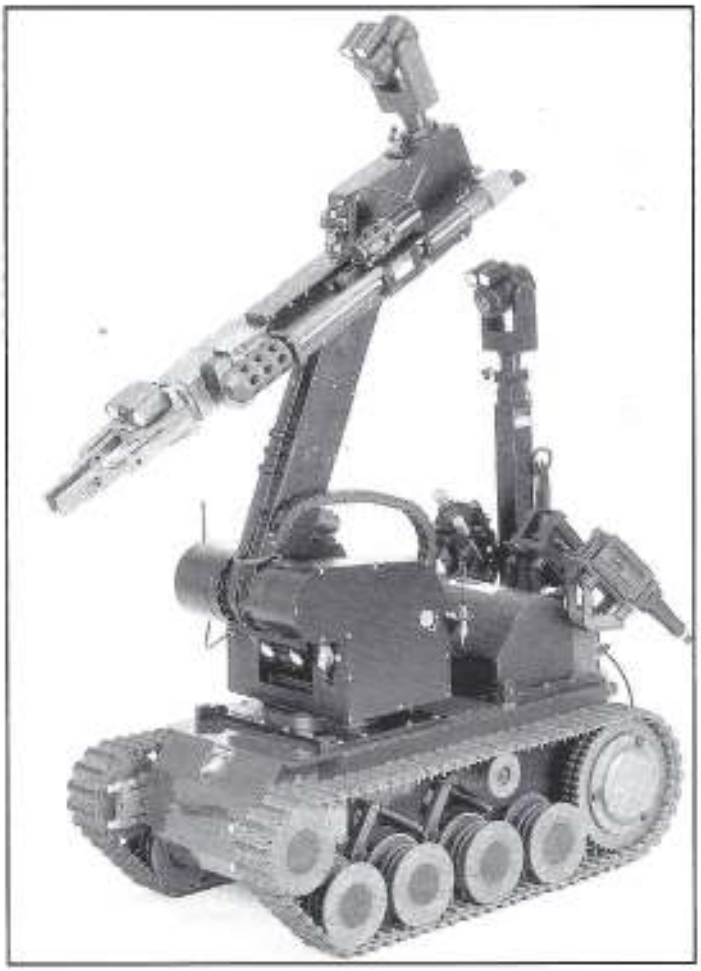
Length: 1.3 m
Width: 0.68 m
Height: 1.1–2.8 m
Scope
vertical: 2.8 m
horizontal: 2.3 m
beneath vehicles: 1.25 m
Electromagnetic compatibility (EMC)
EN 55022 B
EN 61000-4 part 2, 3, 4 and 6
better than 30 V/m
Manipulator arm: 7 degrees of freedom
Telescopic arm: 0–0.4 m
Payload: 30 kg
Cameras: 4 colour cameras with lighting
Control: radio control up to 1 km distance, optional fibre-optic cable control

Status

Available.

Contractor

telerob Gesellschaft für Fernhantierungstechnik mbH.



tEODor remote-controlled manipulator vehicle (telerob)
0123502

Israel

Guardium

Description

The G-NIUS Guardium UGV was originally developed based on the TomCar chassis and it is in this form that it has been ordered by the Israel Defence Force, with deliveries already underway and in-service capability expected before the end of 2009, and evaluated in 2008 by Israel's Airport Authority. Key roles are as a patrol, route proving and convoy security, reconnaissance and surveillance, and combat logistic support platform. G-NIUS, a joint venture of Israel Aerospace Industries and Elbit Systems, is now promoting the Guardium as a system which can be applied to a range of existing platforms.

Guardium has already been deployed to the Gaza strip.

Key payloads tested or deployed on the Guardium include day/night camera, hostile fire indicator, electronic counter-measures, two-way audio system, radar, communications intelligence and electronic support measures systems, lethal and non-lethal reaction equipment, metal detector and communications/observation mast. While the primary role is

Guardium was evaluated in 2008 by Israel's Airport Authority (G-NIUS)
1296995

as a sensor carrier the option for arming the vehicle with a remote control weapon station has been suggested by the company.

Meir Shabtai, vice president of research and development at G-NIUS told Jane's in mid-2008 that plans are underway to increase the maximum payload of the vehicle to 1,300 kg from 300 kg.

Described by the company as the first "operationally deployed autonomous UGV" the Guardium is capable of a high-level of self control, including setting its own route and overcoming obstacles, and can be networked to co-operate with other Guardiums.

Specifications
Guardium
Height: 2.2 m
Width: 1.8 m
Length: 2.95 m
Gross weight: Platform dependent
Speed: 80 km/h
Turning circle: Platform dependent
Payload: 300 kg

Status
In service, deliveries continuing.

Arming of the reconnaissance Guardium remains an option (G-NIUS) 1169699

Contractor
G-NIUS.

Hornet Mk 5 EOD remotely operated vehicle

Description
The Hornet is a compact 94 cm long and 60 cm wide, lightweight (113 kg) EOD Remotely Operated Vehicle (ROV) which can be transported to the scene of an incident in a small commercial vehicle. In addition to its EOD role, it can also be used for reconnaissance and remote surveillance, gas and chemical fume detection and perimeter protection tasks. ROVs of the Hornet family have seen extensive use with the Israeli police forces, US police departments, German police and others.

The Hornet is a tracked vehicle powered by electric batteries that give it a 2 hour operating time. In standard form it has one manipulative arm with five degrees of freedom, capable of lifting 20 kg, maximum vertical reach of 1.70 m and can fire at or grasp an object under any size of car. The arm wrist is connected to a video camera for coverage of wrist action and for weapon aiming.

A second camera is pan and tilt mounted, with remote-controlled zoom and focus as an option for both cameras. Command is by radio link, using individually coded digital commands. The vehicle can be controlled up to a range of 0.5 km.

Attachments such as shotgun, disruptor and claw are available.

Specifications
Length: 0.94 m
Width: 0.6 m
Weight: 113 kg
Lifting capacity: 20 kg
Vertical reach: 1.70 m
Operating time: 2 h
Operating range: 0.5 km

Status
Available.

Contractor
Israel Military Industries (IMI) Limited.

Hornet Mk 5 EOD ROV
0516575

TSR-650 Wasp EOD remotely operated vehicle

Description
The TSR-650 is a wheeled EOD Remotely Operated Vehicle (ROV) which was developed from and has seen extensive operational use by the Israel Defence Force, US Army, US Air Force, German police and others. In addition to its EOD role, it can be adapted for NBC analysis, remote surveillance, riot control, perimeter protection, firefighting and as a weapons system base.

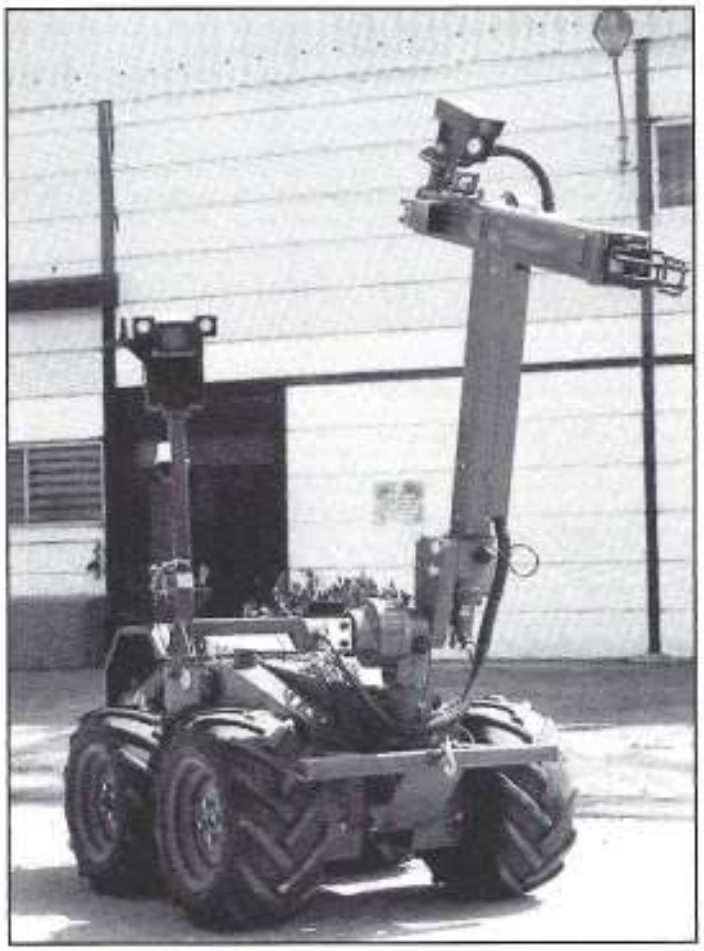
The vehicle runs on four driven wheels shod with low-pressure high-flotation tyres, giving it high manoeuvrability and excellent cross-country ability. Each wheel has a separate motor and the vehicle can turn on its own axis. The multifunctional arm has seven degrees of freedom and reaches to a height of 3.20 m from floor level. It can also lift up to 140 kg. The secondary arm is usually used to mount a camera. A hydrostatic drive system operates on all wheels through independent motors and the speed is infinitely variable up to a maximum of 10 km/h. Control is normally by remote radio operation with coded transmission and a working range of up to 3.5 km. Alternatively, cable control may be specified as an option.

The main arm can extend to 3.05 m range. The vehicle payload is 295 kg. Optional equipment which can be fitted includes the usual shotgun, disruptors, sampling and monitoring equipment, tear gas launchers, claws, grabs and towing attachments. A colour camera with remote-control zoom and focus is capable of panning through 356° and tilting 110°. The arm camera is monochrome. There are two remotely selected video channels, and illumination for night work is provided. The vehicle weighs 650 kg in standard operating form and is powered by an 18 hp petrol motor driving a 12 V DC generator.

Specifications
Weight: 650 kg
Propulsion: 4WD
Speed: 10 km/h
Payload: 295 kg
Turning circle: own length
Power: 18 hp petrol motor driving 12 V DC generator
Manipulator arm
Max capacity: 140 kg
Max length: 3.2 m

Status
In service in Israel.

Contractor
Israel Military Industries (IMI) Limited.



TSR-650 Wasp EOD robot
0516574

Netherlands

High mobility TUGV base frame platforms

Description
TUGV base frame platforms are designed to meet the need for small, inconspicuous, remotely operated and autonomous field reconnaissance vehicles.

The VTE-3500 High Mobility Base Frame Platform is fitted with 100 mm wide fine pitch, wear-resistant steel tracks for smooth and quiet running, as well as long-life operation. The track system is also fitted with a fully balanced road-wheel. Its use of electric power packs and the absence of gearboxes allows for low noise production and a small infra-red radiation image. The platform can wade into water to a depth of 2.5 m.

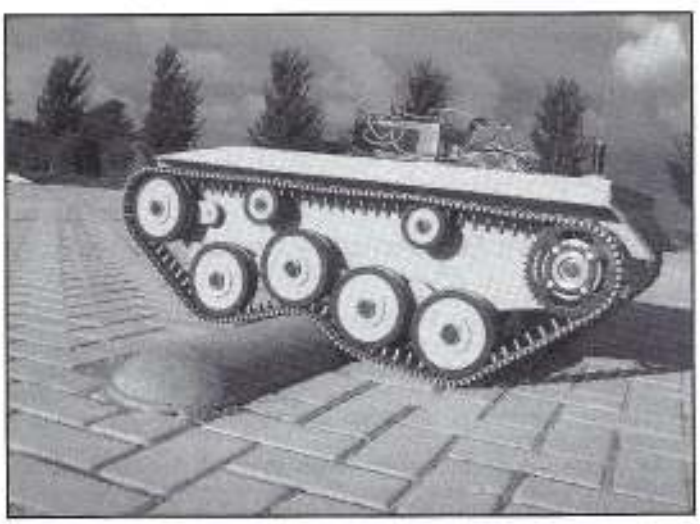
Provisions are made to accommodate day and night video cameras, thermal imaging equipment, X-ray equipment, an integrated position locating system, laser range-finder, acoustic detection system, a real-time data-transmitting system and robot arm manipulators for EOD work.

The platform can operate in most climates and weather conditions and is adaptable to specific customer needs. Each VTE-3500 package includes a handheld wire control set, a hand-held RC transmitter and some spares.

On 01 January 2008, the design, development and production of the VTE-3500 High Mobility Base Frame Platform was taken over from King Metaal Machinefabriek b.v. by Van Brummelen Machinefabriek b.v.

Specifications
VTE-3500
Length: 1.15 m
Width: 683 mm
Height: 385 mm
Weight: 283 kg
Suspension: Helicoil torsion springs and torsion bars
Spring articulation: 100 mm
Track width: 100 mm
Track length: 500 mm
Minimum turning circle: 1.318 m
Underbelly clearance: 110 mm
Range (max)
dry, smooth, horizontal concrete: 12 km
cross country: 8 km

VTE-3500 base frame platform (hull and deck uncoated)
(Van Brummelen Machinefabriek b.v.) 0589843



Wheel articulation of VTE-3500 base frame platform
(Van Brummelen Machinefabriek b.v.) 1341090

The Cheetah VTE-3500 step crossing capability
(Royal Netherlands Army) 1178602

The Cheetah VTE-350 high mobility reconnaissance platform
(Parosha Innovators) 1295418

Payload: 90 kg
Max gradient: 45°
Max side slope: 35°
Max towing force on tracks: 2 kN (1 kN on each track)
Operating temperature range: –10 to +65°C
Range of RC system: 2,500 m
Battery type RC-transmitter: 9 V block type: 6F22
Battery RC-receiver: 1 lead/acid battery (12 V 7,2 Ah)

Status
In service, deliveries and further development ongoing.

Contractor
Van Brummelen Machinefabriek b.v.
Parosha Innovators.

Norway

Blaster EOD robot

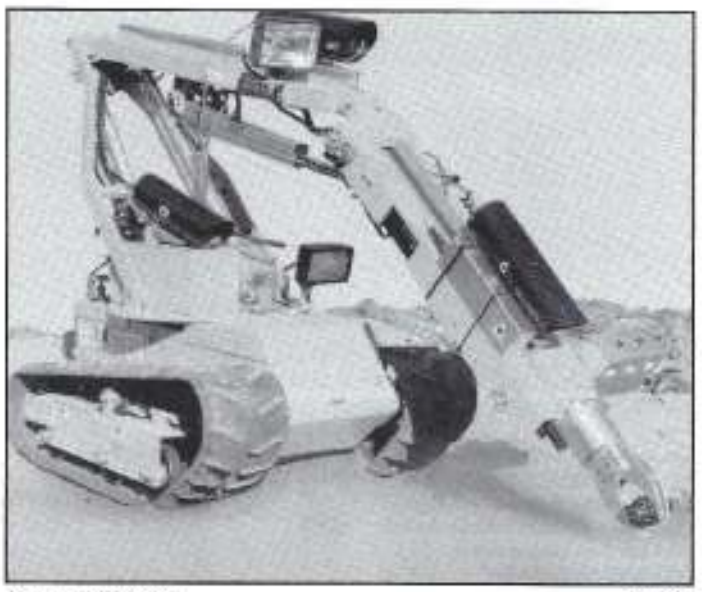
Development
The Blaster EOD robot was developed to meet a requirement of the Royal Norwegian Army.

Description
Blaster is a self-powered remote-controlled vehicle capable of performing all types of EOD and explosive ordnance reconnaissance tasks, as well as being of use in firefighting, rescue and observation roles. It has been developed as a result of many years of experience in the design and manufacture of remote-controlled submarine robotic vehicles.

The basic structure is robust and the built-in battery pack gives between 4 and 5 hours of operation, although a cable can also be provided for continuous power supply. Control from the remote console can be by cable or radio. Blaster has a car towing attachment, can lift 100 kg with its flexible seven-function manipulator arm and is stable in all types of terrain. The robot is equipped with video cameras and can also be equipped with a shotgun and up to three water disruptors.

Status
Believed to be available.

Contractor
SM Steinsvik Maskinindustri AS.



Blaster EOD robot 0515808

Poland

PIAP EXPERT

Description
The EXPERT is primarily designed for use within transportation and confined spaces. The robot has a narrow profile but is provided with mechanical lateral stabilizers that can be retracted when not in use, reducing the width by 8 cm. EXPERT is equipped with two sets of caterpillars, the smaller of which can be used to elevate the base unit as well as aid in ascending and descending obstacles by providing stability.

The system is equipped with six colour video cameras, four of which are mounted on the gripping device on the manipulator which can extend to three metres; the primary camera of these can rotate through 360° and 90° vertically. Two cameras are also located on the sides of the front caterpillars.

In addition to the gripping device the manipulator is fitted with position and gripping force sensors and also an omnidirectional microphone. It can also accommodate a range of tools for use in the EOD role; the primary device used for detonation is a disruptor.

The system can be wire or radio controlled. When operated via wire, automatic charging of the internally located batteries occurs when the vehicle powered by a 230 V source. The operational time of the batteries is between four and eight hours depending upon the tasks undertaken. The robot's speed is variable up to 2 km/h, and there is an ability to reduce the maximum speed by up to 20 per cent.

The control unit is housed in a ruggedised suitcase, and features a colour LCD screen showing the feeds from the robot's cameras, and also an LCD screen that displays a graphic interpretation of the manipulator arm configuration and sensor data. The robot also features an auto-diagnosis system with fault and malfunction alarms.

Specifications
Gross weight : 180 kg
Working time with power supply from battery: 2–6 h
Speed: 2 km/h
Range of radio remote control: 800 m (outdoor) 80 m (indoor)
Number of cameras: 4 or 5

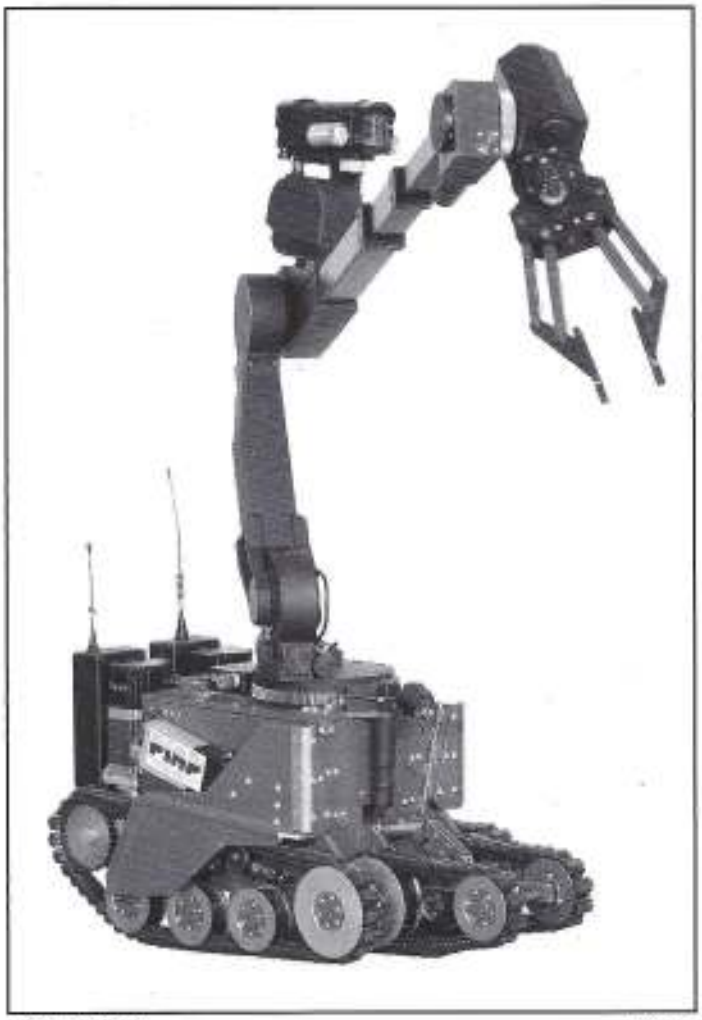
EXPERT control unit 1176884

PIAP EXPERT carrying out an under-car inspection (PIAP) 1143815

Dimensions of the mobile platform (l × w × h): 730 × 450 × 460 mm
Remote control: Radio/cable
Cable length: 5 to 100 m
Operating time on battery power: 4 to 8 h
Max load on folded arms: 15 kg
Max load on extended arms: 8 kg

Status
In production and in service.

Contractor
PIAP.



EXPERT robot 1143816

PIAP EXPERT's manipulator arm has an extended lifting capacity of 8 kg (PIAP) 1176865

PIAP INSPECTOR

Description
INSPECTOR is equipped with two sets of caterpillars, the smaller of which aids in ascending and descending obstacles and movement over uneven terrain by providing stability. The robot is able to tow vehicles up to 1500 kg in mass; its manipulator arm can lift 30 kg fully extended and 60 kg when folded, and has a base that can rotate through 360°.

The system is equipped with four colour video cameras, located on the gripper, manipulator, front and rear of the robot; the main camera (on the manipulator) can rotate through 360° and 90° vertically.

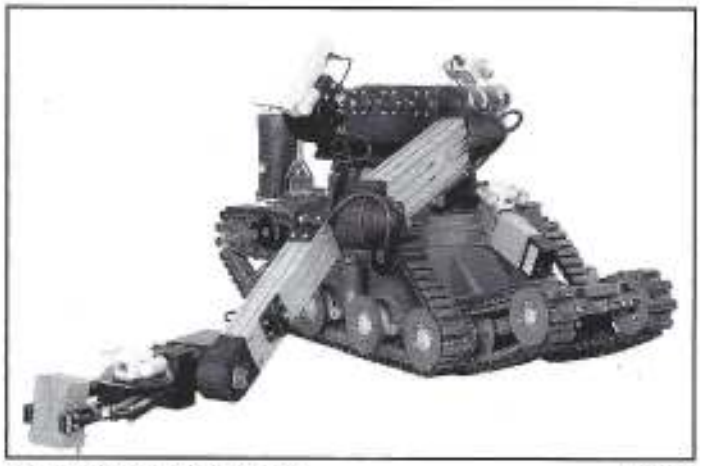
In addition to the gripping device the manipulator is fitted with position and gripping force sensors and also an omni-directional microphone. It can also accommodate a range of tools for use in the EOD role; the primary device used for detonation is a disruptor.

The system can be wire or radio controlled. When operated via wire automatic charging of the internally located batteries occurs when the vehicle is powered by a 230 V source and the operational time of the batteries is between two and eight hours depending upon the tasks undertaken. The robot's speed is variable up to 2 km/h, with the ability to reduce the maximum speed by up to 20 per cent.

The control system enables simultaneous control of all devices and the unit is equipped with three LCD screens that display the feed from the on-board cameras as well as a graphic representation of the position of the manipulator and front caterpillars. To aid use in the dark the control keyboard can be illuminated.

Manipulator arm attachments include:
- Benelli M1 Super 90 automatic shotgun
- WP20 and WP26B disruptors
- Richmond RE 70 disruptor
- Golden Inspector XR-200 and DIMAP x-ray devices
- Chemical detectors, device for breaking car windows and scissors

PIAP INSPECTOR UGVs can operate at a gradient up to 35° (PIAP) 1143819



INSPECTOR mobile robot (PIAP) 1176868

INSPECTOR with disruptor on manipulator arm 1143821

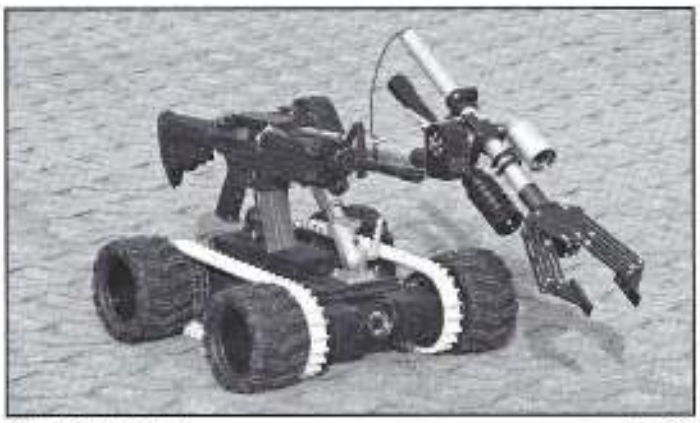
Specifications
Dimensions (l × w × h): 1,710 × 670 × 1,140 mm
Gross weight: 550 kg
Remote control: Radio/cable
Range of transmission: 800 m outdoor, 80 m indoor
Robot run time: 2–8 h on batteries
Max load: 60 kg folded arms, 30 kg extended arms
Cameras: 4 colour camera with halogen headlights (2 × 20 W) or high-power LED
Weight of operator's post: 107 kg
Video screen: 15 in colour LCD
Operator's post run time: 4 h batteries

Status
In production and in service.

Contractor
PIAP.

INSPECTOR control unit
1176867

PIAP Scout



Scout Robot (PIAP) 1239283

Description

The Scout robot chassis was designed as a compact vehicle equipped with two cameras. Both cameras are equipped with their own illuminators. Due to its compact size and light weight the Scout robot can be transported in a backpack. The small robot overall dimensions enable for swift inspections of not only both confined and hard to reach compartments, but also of car chassis, ventilation shafts, and even for cave and mining shaft exploration.

The robot is efficient in overcoming uneven terrain such as obstacles and kerbs. It is able to carry loads with its manipulator from 2 kg (with the manipulator fully extended) and up to 5 kg (with manipulator folded). The wheels are easy to dismantle.

The Scout features:

- Modular structure enables quick and simple change of components
- Obstacle crossing capability
- Remote control with fibre optic wire
- Small manipulator
- Manipulator equipped with a gripper and one or two joints to operate a gripper
- Two additional cameras
- Disruptor
- Other devices adapted by special request.

Specifications

Dimensions, with wheels (hxwxl): 180 × 543 × 1,530 mm
Dimensions, without wheels (hxwxl): 145 × 328 × 1,495 mm
Weight: 13 kg
Max speed: 10 km/h
Height: 0.18 m
Length: 0.53 m
Operating duration: 2 h
Max climb gradient: 50°
Fording depth: 0.05 m
Radio control range: 100 m
Fibre optic range: 300 m

Status

Development complete. In production.

Contractor

PIAP.

PIAP Scout with control station in background (Jane's/Patrick Allen) 1345728

Spain

Aunav

Aunav operations robot (Jane's/Patrick Allen) 1031252

Description

The Aunav is an electro-hydraulic operated six-wheeled remote-controlled robot.

The fully articulated arm is mounted on a turret with a limited turn motion. The arm has four joints giving free vertical movement. It has four high-resolution video cameras (can possibly have two more) and a dome camera with pan, tilt and zoom functions. Illumination is provided by four halogen headlights.

Remote control is provided by a dedicated PC-based console with joystick giving precision motion control. The screen can be used to show both the machine's operational conditions and the images relayed from its on-board cameras, at the same time.

Couplings are provided to attach water guns, shotguns and disruptors. Several special pincers are available for cutting, carrying, pulling and destruction of objects.

Specifications

Length: 1,670 mm
Width: 620 mm
Height: 1,150 mm
Extended arm length: 2,700 mm
Total weight: 400 kg
Operating time: 4 h
Wheel traction force: 500 kg

Status

In production and in service.

Contractor

Proytecsa.

United Kingdom

Bison™ remotely controlled vehicle

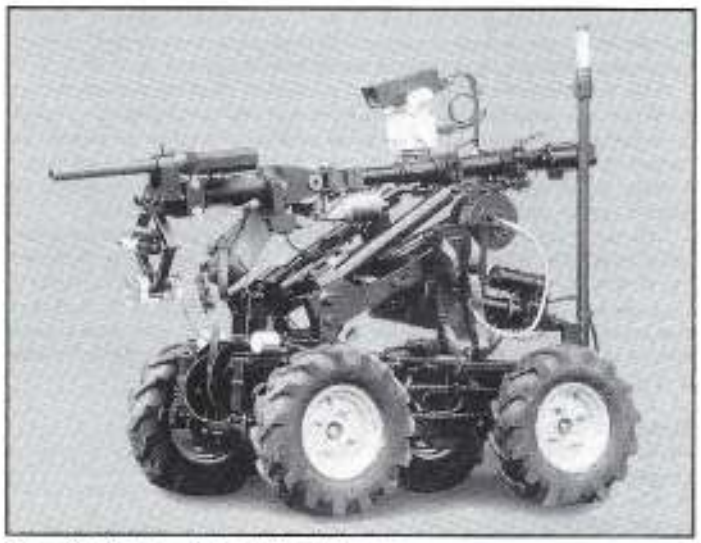
Description

Bison™ is a remotely controlled, four-wheel drive, skid-steer vehicle with a high degree of mobility and the capability of carrying a 100 kg payload designed for the disposal of unexploded ordnance (UXO) and improvised explosive devices (IED).

Bison™ is electrically driven, with a permanent magnet DC motor powering the wheels on each side of the vehicle. Power to the motors is provided from a pair of onboard, sealed lead acid battery packs, connected in series.

The vehicle is equipped with a modified Mk8 Wheelbarrow top hamper, to which a number of weapon attachments are fitted.

Bison™ and Groundhog™ (see separate entry) operate using a common control system. The video and data radio units are identical and they have programmed set frequencies to allow inter-operation between both vehicles. The hand control units are also identical and interchangeable between either vehicle. The hand controller features a 5 inch LCD colour monitor, paddle joystick, function select button operation, sound feedback with volume control, video and data radio control (fibre-optic cable communication is optional), camera changeover and dimmer control. A video output is available to allow use of an external monitor.



Bison™ EOD/IED vehicle (AB Precision) 0074309

Specifications

Length: 1.1 m
Width: 740 mm
Height
min: 400 mm
max: 2.5 m
Ground clearance: 200 mm
Weight: 210 kg
Tyres: 410 × 8.00 × 4 tractor tread
Speed: 0–4 km/h
Turning circle: 1,100 mm neutral
Climbing: max 40°
Range: 1 km line of sight
Endurance: max 2 km
Camera 1 – observation: colour, 24 x zoom, high-speed auto-focus lens, electronic image stabilisation, PAL, 460 TV lines
Camera 2 – driving and forward: colour, 7.5 mm auto-iris lens, PAL, 470 TV lines
Camera 3 – driving (reverse): colour, 7.5 mm auto-iris lens, PAL, 470 TV lines
Lights: 12 V, 20 W halogen with dimmer control

Status

In service. No longer in production.

Contractor

AB Precision (Poole) Limited.

BombTec™ Defender IEDD remotely operated vehicle

Description

The BombTec™ Defender from Allen-Vanguard draws on more than 30 years experience of escalating terrorist sophistication and is designed to cope with present and future threats. As well as providing advanced features to deal with developing terrorist techniques, such as nuclear, biological and chemical devices, the principal of a strong, robust, versatile but reliable vehicle are fundamental to the design.

The vehicle is constructed using high strength, lightweight titanium and has an articulating rear axle. Operational control is either by umbilical cable (150 m as standard), or by wireless spread spectrum radio frequency telemetry to a range of up to one km line-of-sight using an omnidirectional antenna. The vehicle is of modular construction; simplifying maintenance and adding flexibility to its mission profile capability.

Other features include its 6-wheel independent direct drive, that it is environmentally sealed to facilitate chem-bio 'wash down' and that it has the capability to integrate networked sensors and devices such as a chemical agent detector, stethoscope or electronic countermeasures.

BombTec™ Defender (Allen-Vanguard) 1154180

Specifications

Power: 24 V DC high capacity deep cycle long life batteries
Radio control: 2.4 GHz encrypted spread spectrum
Drive: 6-wheel independent direct drive
Speed: 0–3.2 km/h (0–2 mph), infinitely variable
Dimensions: 75 × 152 × 115 cm
Weight: 275 kg
Turning circle: own diagonal length
Max gradient: 45°
Rotation turret: ±385°
Claw rotation: continuous in both directions
Claw capacity: 300 mm
Horizontal reach: 1.5 m
Lifting capacity
arm retracted: 75 kg
arm extended: 30 kg
Wrist rotation: +20° to –90°
Rear camera
tilt: +45° to –80°
pan: ±175°
Lights: ultra-bright high efficiency LEDs

Status

In production and in service.

Contractor

Allen-Vanguard (formerly PW Allen & Company Limited).

BombTec™ Responder IEDD remotely operated vehicle

Description

The BombTec™ Responder from Allen-Vanguard is a small, high specification, robust and powerful remotely operated vehicle designed for reconnaissance and weapon delivery in rapid deployment scenarios within areas of restricted physical access. Responder features a digital electronic control system to provide operators with a highly flexible and agile machine that delivers maximum feedback at the incident control point.

The vehicle features distributed architecture electronic infrastructure (the robot and all of its electronics devices are configured as a computer network)

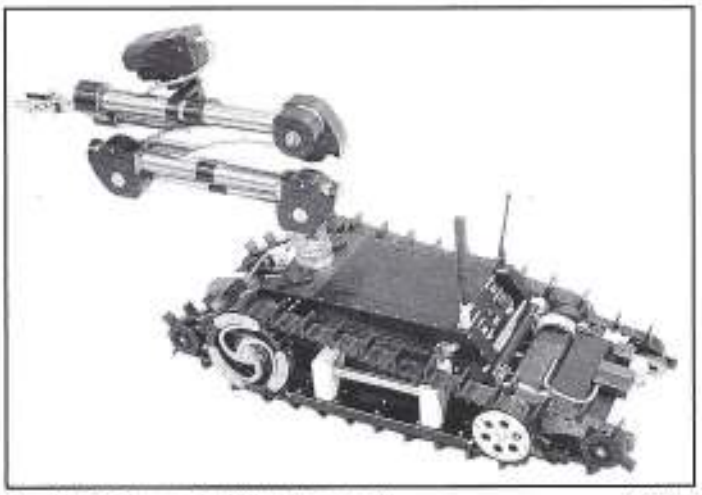
that allows other items of equipment to be delivered as part of its mission payload and then be remotely operated form the control console. The radio control system uses a purpose-built encrypted spread spectrum radio frequency system that carries the bi-directional telemetry control and the twin video streamer output. Alternatively a 'twisted pair' or fibre-optic cable control can be used at distances of up to 400 m.

Drive and proportional speed is by a joystick, allowing the unit to turn within its own diagonal length. The front and rear ramp sections provide an adjustable footprint and this gives additional traction to permit the vehicle to negotiate obstacles otherwise prohibitive. The track has a 4-motor drive system for improved power and traction, especially for climbing stairs and on slopes. An optional wheel kit is available.

Titanium construction gives a high power to weight ratio and increased operational life from the quick release battery pack. The 3-section removable manipulator arm has a 1.5 m reach with a load capacity of 5 kg and is capable of delivering a lightweight or single shot disruptor. The manipulator incorporates six axes of movement and uses a quick release mechanism for fast deployment and easy storage of manipulator accessories.

Specifications

Power: 24 V 13.5 Ah battery
Length: 800 mm
Width: 450 mm
Height: 260 mm
Arm (closed): 600 mm
Reach
vertical: 1,600 mm
horizontal: 1,500 mm
below ground: 300 mm
Weight: 72 kg
Speed: 2.16 km/h
Turning circle: own diagonal length
Max gradient: 36°



BombTec™ Responder (Allen-Vanguard) 1041275

Max obstacle: 150 mm
Cameras: 3 (1 with zoom)
Lights: 2 x 24 W
Turret pan: ±140°
Turret tilt: –10° to ±15°
Control cable length: 150 m

Status

No longer in production.

Contractor

Allen-Vanguard (formerly PW Allen & Company Limited).

Buckeye EOD

Description

Buckeye is a radio- and fibre optic-controlled mini-tracked vehicle capable of stair-climbing and mounting a number of accessories such as water disruptors and manipulators. The vehicle has the capability to mount both colour and monochrome cameras. Uses include surveillance in hostile situations and bomb neutralisation. Because of its size it can be operated in small areas such as inside aircraft and buildings not suitable for larger robots.

Status

Original model in service with the UK MoD. Superseded by the Cyclops series (see separate entries).

Contractor

AB Precision (Poole) Limited.

Buckeye Mini EOD robotic vehicle 0515812

Cutlass

Description

The Cutlass programme provides what is Remotec's latest unmanned ground vehicle for explosive ordnance disposal (EOD) and is used by the Ministry of Defence (MoD) for anti-terrorism operations worldwide.

The Cutlass system offers the latest technology in a modular design, allowing the user to deal with the full range of both military and improvised explosive devices. Its versatile design means that it is capable of accommodating a wide range of payloads, sensors and tools.

The manipulator arm is equipped with a state-of-the-art gripper and has 9° of freedom for greater movement and agility inside limited spaces, such as the interior of a car. The robot is able to travel at slow speeds for delicate operations and may accelerate to high speeds to enable rapid travel. The six-wheeled design offers mobility on all types of hard and soft terrain and in all weather conditions.

QinetiQ is providing the vehicle command and control systems. QinetiQ's user-friendly operator command console will combine manual

Cutlass remote EOD vehicle (Northrop Grumman) 1296396

Cutlass remote EOD vehicle (Northrop Grumman) 1295397

Cutlass remote EOD vehicle (Northrop Grumman) 1295398

commands with advanced software to provide the unprecedented functionality required for such a demanding mission environment.

The bulk of deliveries will take place in 2010.

Specifications

Cutlass remote EOD vehicle
Height: 1.27 m
Width: 0.72 m
Length: 1.24 m
Weight: 417 kg
Max speed: 13 km/h
Curb clearance: 0.12 m
Fording depth: 0.50 m
Obstacle clearance: 0.30 m
Control link: Radio control (up to 1 km) or fibre optic cable (up to 500 m)
Power supply: Lithium ion, nominal 40 V complete with battery management system
Number of cameras: 6, with picture-in-picture
Lighting: 4× halogen, 4× LEDs
Manipulator arm
Max lift capacity:
(unextended): 15 kg
Max length:
(vertical) 3.66 m
(horizontal) 2.54 m
Gripper: Three finger, 0.12 m jaw opening

Status

Available.

Contractor

Remotec.

Groundhog™ remotely controlled vehicle

Description

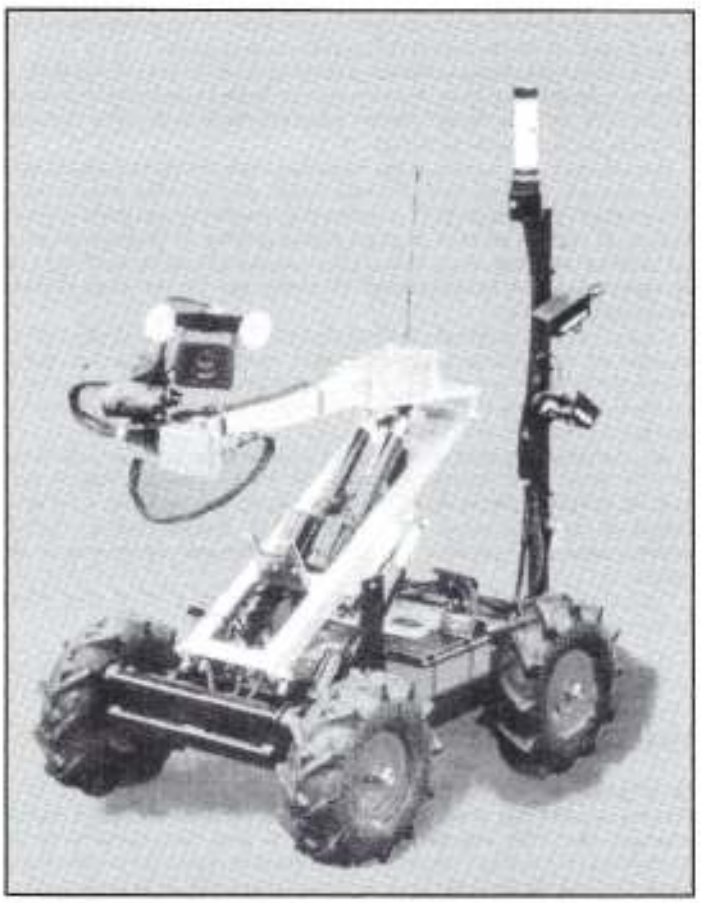
Groundhog™ is a small, lightweight, remotely controlled, four-wheel drive, skid-steer vehicle designed for explosive ordnance reconnaissance (EOR). Its role is to locate and identify unexploded ordnance and improvised explosive devices.

Groundhog™ is electrically driven, with a pair of permanent magnet DC motors powering the wheels on each side of the vehicle. Power to the motors is provided from a pair of onboard sealed lead acid battery packs, connected in series. The camera handling system consists of a variable geometry 'Top Hamper' which has the capability of positioning the camera up to a height of 2 m using a telescopic tube. The pan-and-tilt mechanism for the camera is located at the end of the telescopic tube.

Groundhog™ and Bison™ (see separate entry) operate using a common control system. The video and data radio units are identical and have programmed set frequencies to allow interoperation between both vehicles. The hand control units are also identical and interchangeable between either vehicle. The hand controller features a 5 inch LCD colour monitor or 9 inch CRT colour monitor, paddle joystick, function select button operation, sound feedback with volume control, video and data radio control (fibre optic cable communication is optional), camera changeover and dimmer control.

Specifications

Length: 700 mm
Width: 500 mm
Height
minimum: 400 mm
maximum: 2 m
Ground clearance: 150 mm
Weight: 35 kg
Max speed: 2.88 km/h
Turning circle: 700 mm neutral
Climbing: max 40°
Range: 1 km line of sight
Endurance: 1.5 km (maximum)
Camera 1 – observation: colour, 24 × zoom, high-speed auto-focus lens, electronic image stabilisation, PAL, 460 TV lines
Camera 2 – driving and forward: colour, 7.5 mm auto-iris lens, PAL, 470 TV lines
Camera 3 – driving (reverse): colour, 7.5 mm auto-iris lens, PAL, 470 TV lines
Lights: 12 V, 20 W halogen with dimmer control



Groundhog™ EOR vehicle (AB Precision) 0074308

Status

In service. No longer in production.

Contractor

AB Precision (Poole) Limited.

Guardian

Description
The Guardian MROV is built around a central chassis and various modular elements and is designed for use in hazardous situations where there is a risk to a human operator. It is controlled either through fibre optic cable link or through radio. The standard model has four track modules, each pair (front and back) can be independently positioned to provide mobility in various terrains, including allowing obstacle and stair climbing and manoeuvrability through confined spaces. It is equipped with a hybrid extending and multijointed arm for reaching into areas such as aircraft overhead lockers or difficult-to-access vehicle spaces. The payload head, which has a maximum payload of 10 kg, also provides articulation and positioning of the payload against the target. A four-camera 'picture-in-picture' video system provides the remote operator with full situational awareness.

The control system includes a 17 inch LCD screen within the briefcase-style Operator Control Unit (OCU). A separate touch screen display provides the operator with feedback from the vehicle and operation of subsidiary functions. Key functions have dedicated controls. The control system open architecture allows for a wide variety of sensors and accessories to be interfaced with the vehicle.

Guardian can carry various manipulators and disruptors, including Pigstick, Hotrod, Needle and ABL 1000 and 2000.

Specifications
Vehicle

Length
- track modules extended: 1,280 mm
- normal drive configuration: 768 mm

Height
- wheeled, max: 524 mm
- tracked, max: 504 mm

Width
- wheeled: 535 mm
- tracked: 415 mm
- track width: 50 mm

Speed
- wheeled: 0–9 km/h
- tracked: 0–5 km/h

Extending arm
- max horizontal reach: 2.1 m
- max vertical reach (tiptoe mode): 2.5 m

OCU
- length: 541 mm
- height: 245 mm
- width: 440 mm
- weight: 20 kg
- power: 12/24 V DC or 110/230 V AC

Status
Available.

Contractor
AB Precision (Poole) Limited.

Hadrian EOD robot

Description
Hadrian is a family of second-generation EOD robots which, when combined with the full range of equipment and training offered, finds applications in addition to EOD and Improvised Explosive Device Disposal (IEDD) in particular, for mobile surveillance, hazardous materials handling and remote detection and monitoring of gases.

The vehicle has six drive wheels, each with an independent motor and gearbox drive system. The all-wheel drive combined with articulated front and rear axles give an ability to climb over objects which exceed its wheel height, such as railway tracks, ties, kerbs and long grass.

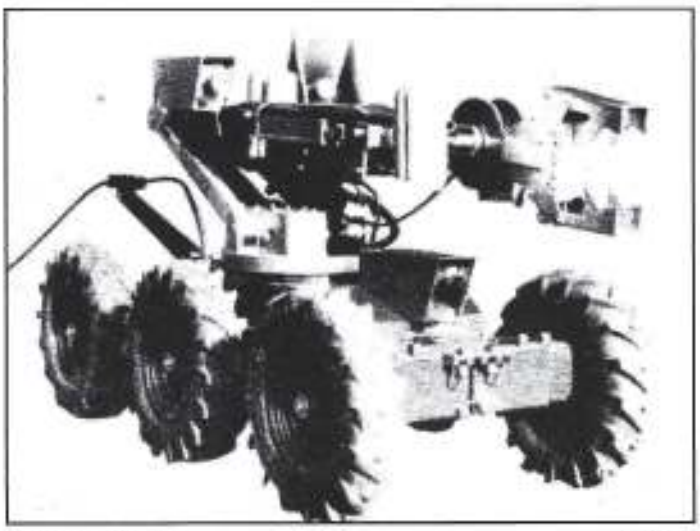
An extending top hamper fitted on a rotating turret carries a manipulating claw to a height of 2.70 m. Hadrian can be folded down to a minimum height of 70 cm. This means that the robot can reach over, under and into a vehicle, yet fold easily for transport.

The weapon arm carries a manipulating claw which has continuous right and left rotation and provides hand- and arm-like movements. The wrist will tilt through 180°, enabling the operator to grasp and retrieve objects as well as perform intricate manipulations of objects weighing up to 10 kg. Alternatively, a heavy claw capable of picking up 75 kg can be fitted quickly. A front-mounted lift scoop can lift and carry objects weighing up to 45 kg.

Hadrian can be equipped with a carrying rod for disruptors and is capable of self-loading these disruptors remotely. A five-shot semi-automatic shotgun is mounted on the weapon arm, and sighted using a dedicated CCTV camera. Two additional secure firing circuits are fitted for operation from the front axle.

For optimum performance, up to four onboard colour cameras can be fitted, with operator control of focus, aperture, zoom, pan and tilt facilities. Alternatively, fully automatic cameras can be fitted. Single or split TV screen is available with graphic overlay giving battery state and machine orientation. A two-way audio link is an option.

Control is by fully multiplexed radio control, with a 225 m long cable option when continuous operation is required.



Hadrian EOD robot 0515813

Specifications
Length: 1.34 m
Width: 0.7 m
Max operating height: 2.7 m
Turning circle: 1.5 m
Weight: 170 kg

Status
No longer in production. Believed to be in service in the UK.

Contractor
Monitor Coatings and Engineers Limited.

Hobo L3A1 robotic vehicle

Description
The Hobo L3A1 has been used mainly in improvised explosive device disposal and EOD situations, although it also has applications in firefighting, the nuclear industry, airfield damage repair, terrorist/hostage situations, the removal of debris and toxic chemicals, or in any situation or environment which is hazardous to human life.

Hobo was built to military standards and specifications and is known to have seen service in at least 22 countries and with 34 agencies, including the United Nations. Combat-proven, Hobo earned its reputation for being a tough, versatile and reliable vehicle from its years of operational experience in all extremes of climate and terrain. Six wheels, each independently driven, give the Hobo the ability to manoeuvre through rough terrain, mud and sand, snow and water.

Operational under radio control, it has a minimum range of 1 km line of sight. The vehicle can also be operated by means of an umbilical cable. A 150 m cable is supplied as standard and further lengths of cable, up to a maximum of 500 m, can also be supplied. Both systems have their own control console for maximum operational capability.

The Hobo system also features: three-camera system, 6-axis manipulative arm, 440° total turret rotation, 180° wrist rotation and 360° claw rotation continuous in both directions. Standard equipment includes a three-camera CCD video system, a two-light system, front and rear arm and claw accessory points, non-NATO batteries and battery charger. The Control Console comes complete with TV monitor, vehicle functions and options controls, DC and AC voltage inputs for console and vehicle operation and additional video output.

A wide range of accessories are available.

Hobo L3A1 negotiating steps 0515805

Specifications
Power: 24 V DC 55 A/h non-spill lead acid batteries, fitted in vehicle. 110 or 220 V AC through console for continuous use
Control: by radio remote control or via umbilical cable
Drive: 6-wheel independent electric drive. Wheels 4.00 x 8 traction
Suspension: front and rear axle articulation controlled by torsion bar
Speed: up to 8 km/h, infinitely variable
Turning circle: own length
Max gradient: 45°
Weight: 228 kg
NATO stock number: 1385-22-115-2025
Radio frequency: 458 MHz standard; special frequencies available
Video frequency: 1.2 GHz, colour, standard; special frequencies available
Line of sight: >1 km
Normal operation: >250 m

Status
No longer in production. Known to have seen service in a number of European countries.

Hobo articulated arm (Kentree Ltd) 0079888

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

Imp miniature EOD robot

Description
The Imp was designed specifically for use in confined areas where access is denied to a larger vehicle. It is ideal for use in aircraft, trains, ships and building interiors. More than a surveillance vehicle, this mini-ROV was produced to be capable of firing both disruptors and a shotgun. Suitably qualified operators can use the unit to deploy specialised EOD equipment such as explosive sniffers, X-ray equipment and surveillance devices.

The vehicle has two sets of tracks which allow it to surmount sizeable slopes and obstructions and also to climb stairs. The Imp is capable of remaining stationary on a 30° slope.

The whole vehicle is of modular construction for easy operation, allowing it to perform varied tasks from simple surveillance to intricate manipulative operations. The standard vehicle was delivered complete with an interchangeable top mounting plate which carries various arm configurations and weapon mounting systems, baggage claws, cameras, disruptors, pan and tilt and various other accessories which include a car hook, rope thrower, motorised grab and a spring claw and line.

The batteries are contained within a quick-change cassette for extended operation, which is also assisted by the onboard battery charging system. Normal control is via radio link, allowing for up to 90 minutes of continuous use without battery change. Operation by cable can be used when a high degree of security is required.

In standard form, the Imp consists of a four-track vehicle with quick-change battery pack, radio and video control, motorised reconnaissance arm, CCD monochrome camera, pan and tilt unit, lights, sound system and antennas. The console has a 9 inch colour monitor, operational controls, detachable hand control with joystick, 100 m cable, antennas, short charge cable, battery charger and carrying case. Operational equipment accessories include shotgun and attachment, disruptor attachment, baggage handling arm, three-sectional motorised arm, motorised claw, colour camera, zoom lens, X-ray unit bracket, rope thrower and various data and video links.

Specifications
Width: 420 mm
Length: 800 mm (with front ramp retracted); 940 mm (with front ramp extended)
Vertical reach: 1.2 m
Horizontal reach: 1.2 m

The Imp examines a suspect car 0515806

Weight: 75 kg
Lifting capacity: 5 kg at 1.2 m
Drag capacity: 75 kg
Drive: 2 or 4 track system from electric motors with worm drive gears
Speed: 0–0.72 km/h
Turning circle: own length
Gradient: 45°
Power: 12 V DC battery pack; 110/220 V AC through umbilical cable for continuous use, or short link for battery charge

Status
No longer in production. It is not known whether the Imp miniature EOD robot is still in service.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

Mk 4C Cyclops remote operated vehicle

Description
The Cyclops Mk 4C compact and lightweight remotely operated vehicle is capable of undertaking a large variety of improvised explosive device disposal (IEDD) and EOD roles.

A cantilevered track system and the ability to change its centre of gravity allow the vehicle to climb stairs. It can carry up to three cameras, real-time X-Ray system, weapon, disruptor, manipulator, chemical and explosive detonation equipment and can be controlled by either radio or fibre-optic link. Sensors can be controlled with a separate control unit, which utilises dedicated control channels in the vehicle system. Data from sensors are fed back to the base station either as part of the video signal or via a dedicated communication channel. A pan and tilt head allows optimum positioning of a disruptor or camera system. Cyclops' small size and proportional joystick control enable it to manoeuvre in confined spaces such as narrow aisles in trains, buses and aircraft, while the 2 m extendable boom allows it to search overhead luggage racks or lockers and under the seats of vehicles.

Cyclops can be rapidly deployed into its operational environment.

Specifications
Weight: 27 kg
Length: 870 mm
Width: 395 mm
Height
minimum: 210 mm
maximum: 2,000 mm

Status
In service and supplied to overseas military, army, navy, police and special forces. Superseded by the Mk 4D Cyclops (see separate entry).

Mk 4C Cyclops (AB Precision) 0074408

Contractor
AB Precision (Poole) Limited.

Mk 4D Cyclops remote operated vehicle

Description
The Cyclops Mk 4D is the latest development in the Cyclops series, having been developed from the Mk 4C variant (see separate entry) for use in improvised explosive device disposal (IEDD), high-risk search and remote operation in hazardous environments.

Like the Mk 4C, the 4D is a compact vehicle, able to manoeuvre down narrow aisles in trains, buses and aircraft, while its extendable boom allows it to search overhead luggage racks or lockers and under vehicle seats.

The Mk 4D's improvements include: a 40 per cent improvement in battery duration, battery indicator, two-speed extending mechanism, variable two-speed drive capability, brakes, four firing circuits, four-camera system, colour zoom head camera with night vision capability, symbolised hand controller, modular manipulator and weapon mounting system, improved terrain capability and a high-definition TFT LCD screen. Removable wheels enable off-road and rough-terrain operation. The vehicle has variable two-speed driving capability (0 to 5 km/h and 0 to 8 km/h) on tracks.

Cyclops is supplied complete with a compact base station and a range of operating accessories.

Specifications
Weight: 34 kg
Width:
(tracked) 395 mm max
(wheeled) 535 mm max
Length:
(drawbridge down) 870 mm
(drawbridge up) 790 mm
Height: 400 mm (stowed)
Speed:
(tracked) 0–3 km/h
(wheeled) 0–6 km/h
Fording capability:
(tracked) 65 mm
(wheeled) 135 mm
Towing capability: 1,000 kg (terrain dependent)

Mk 4D Cyclops with modular manipulator and weapon mounting system (AB Precision) 0137400

Status
In service with the UK MoD and supplied to military, army, navy, police and special forces elsewhere.

Contractor
AB Precision (Poole) Limited.

Moonbuggy™ EOD

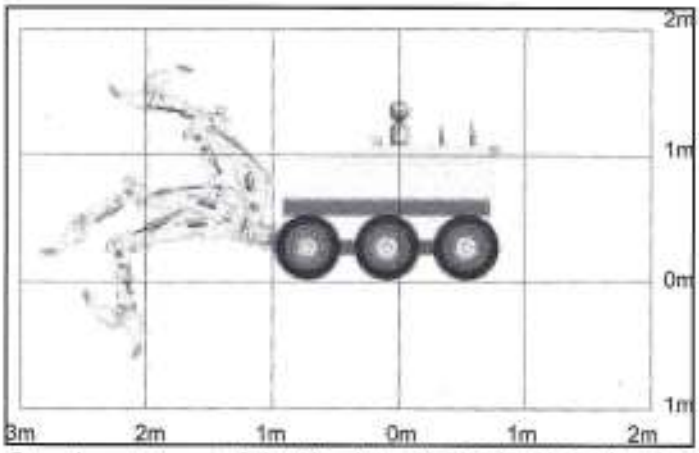
Development
The Moonbuggy™ EOD unmanned ground vehicle (UGV) is designed for rapid deployment and use in dealing with EOD and IED situations.

Description
The Moonbuggy™ EOD robot can be deployed using a single operator. It can be easily transported by using a standard off-road trailer. The Moonbuggy™ UGV has a modular control system and an easily serviced diesel engine which gives reliable field operation without the need for specialist support. The arm is fitted with a forward facing forked bucket with optional gripping fingers.

The Moonbuggy™ can carry a range of optional sensors including radiation, gas and biological. Readings from the sensors are overlaid onto the video output display.

Video transmission options
- 1.3 GHz 1 Km near line of sight RF link
- 50 m cable Umbilical
- 1 km + single use fibre optic cartridge

Moonbuggy™ remote operated EOD robot (Smith Engineering) 1334716



General arrangement of the Moonbuggy™ EOD (Smith Engineering) 1334717

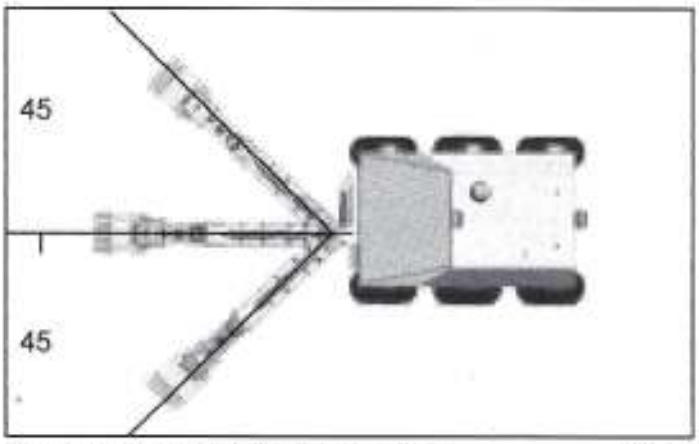
Video system options
- Thermal imager

The Video system consists of four cameras with an on screen display of vehicle data. There are wide angle navigation cameras front and rear, a pan-tilt zoom and arm camera. Each camera can be viewed individually as a full screen or as part of a quad display.

Control options
- 433 MHz RF 1 km+
- 50 m cable Umbilical
- 1 km + single use fibre optic cartridge

Specifications

Dimensions
Length: 2.2 m (arm in transport position)
Width: 1.25 m
Height: 1.5 m (arm in transport position)
Power
Engine: 33 hp
Fuel: diesel
Speed control: full proportional
Transmission: hydraulic
Turning circle: zero
Speed: 19.3 km/h
Steering: skid
Weight: 900 kg



Moonbuggy™ arm reach (Smith Engineering) 1334718

Status
In production.

Contractor
Smith Engineering (GB) Ltd.

Revolution remote EOD vehicle

Description
Revolution is the latest addition to the Wheelbarrow family of remote EOD vehicles. The Revolution is designed to be used in confined locations, such as parked cars. The vehicle is equipped with a turret that enables operational equipment to be rotated through 360° around the chassis. The Revolution is based on the Wheelbarrow MK8 Plus II (see separate entry) and has an interchangeable top deck.

The turret and articulating link are used to support a bridge onto which can be fitted a boom and modular weapon mounting system, thus allowing a number of disruptors and a variety of additional fittings to be mounted. Four cameras are mounted on the vehicle, and all four views are simultaneously displayed at the incident control point. Any combination of 'picture-in-picture' and vertical or horizontal split is available, making the vehicle suitable for surveillance tasks, as well as its IEDD role. A 2-way audio system is also available. Command is via cable (150 m), fibre-optic link (up to 500 m), or radio (1 km line-of-sight). The system can travel at speeds of up to 5 km/h, has a climbing ability of 45°, and a maximum of 150 kg payload, it is able to turn within its own length. The reach and rotation of the extendable arm is 6.4 m and 185°. The battery power system can be charged via a remote trickle charge. The system has been tested for International CBRNE deployment.

Status
In production.

Contractor
Remotec UK Limited.

Revolution remote EOD vehicle (Remotec UK) 1299276

Super M remote EOD vehicles

Description

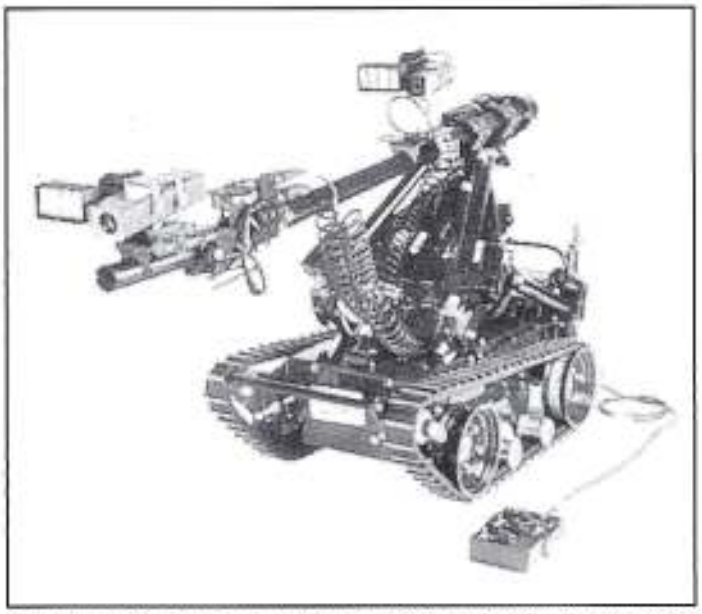
The Super M is the latest development in the Wheelbarrow Mk7 series of remote-controlled vehicles and is offered as a reduced-cost option for areas with a lower threat assessment. Over 500 of these vehicles have been produced and have been used in service in about 40 countries. Existing Mk7 Wheelbarrows can be refurbished or upgraded to Super M standards.

Upgraded features include a common top hamper, shared with other Remotec UK remote EOD vehicles. This enables the latest EOD weapons and countermeasures to be easily fitted. The Super M also has a common interface with Wheelbarrow Mk8 spares and accessories and the same camera options as the Mk8 Plus.

The modular construction of the top hamper allows a wide variety of cameras, disruptors, weapons, manipulators and detection equipment to be mounted. Powerful electric actuators are used to elevate and extend the boom, with a further Modular Weapon Mounting System (MWMS) enabling a variety of equipment and accessories to be placed at almost any angle, including vertically up or down.

Specifications

Width: 69 cm
Length, without tube: 121 cm
Turning circle: own length, neutral turn
Operational weight: 204 kg
Track system: rubber track friction drive
Speed: 0–3 km/h
Gearbox: 1 speed
Number of firing releases: 4
Number of cameras: 2
Lighting: 2 × camera lamps, 1 × spotlight
Camera mounting: 1 × pan unit, 1 × pan and tilt unit
Power supply: 24 V gel type batteries
Range
cable: 100 m
radio: 200 m urban
Max reach with telescopic tube: 2.7 m to weapon arm tip



The Super M is the latest development in the Mk7 Wheelbarrow series (Remotec UK) 0074347

Lift capability
extended: 6.5 kg
retracted: 112 kg
Track geometry: fixed

Status

No longer in production. In service with EOD units in about 40 countries.

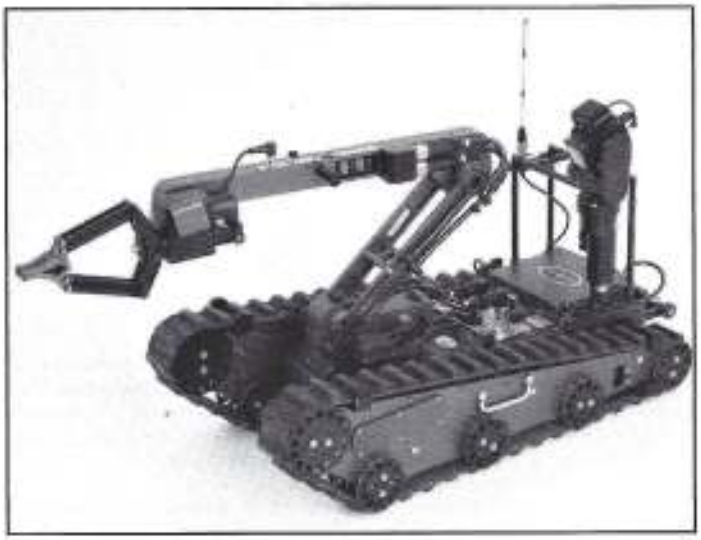
Contractor

Remotec UK Limited.

Vanguard™ remotely operated vehicle

Description

Vanguard™ represents Allen-Vanguard's newest generation of high-risk-use robots for responding to CBRNE and Explosive Ordnance Disposal (EOD)/Improvised Explosive Device Disposal (IEDO) threats, hazardous materials (HAZMAT) operations and tactical and surveillance needs. The manufacturer claims that the Vanguard™ possesses increased ground speed, longer mission duration, improved ruggedness and dual independant firing circuits as advantages when compared to its rivals.



Close-up of Vanguard™ ROV (Allen-Vanguard) 1341910

Vanguard™ ROV in operation on gravel (Allen-Vanguard) 1341913

Vanguard™ ROV with Disruptor (Allen-Vanguard) 1341916

Vanguard™ remotely operated vehicle in sandy conditions (Allen-Vanguard) 1341914

The advanced modular design facilitates easy field repair – a critical success feature for remote locations or distant combat threats, while its compact size/weight envelope aids rapid deployment in all civil law enforcement or military scenarios. Enhancements or improved features compared to its predecessors include simultaneous use of multiple features; two-way digital audio communication, 10 × zoom camera, integrated RS-232 port for additional sensing and integration of detection devices for CBRNE operations with the command unit. The Vanguard™ laptop computer-based Command and Control Unit (CCU) boasts multi-functional capabilities, ease-of-use and a highly intuitive user interface which is identical in its operation and expandable digital architecture to its sister ROV, the Defender. The CCU is interoperable between multiple ROVs and between models.

The Vanguard™ also features an improved centre of gravity and optimised lifting capacity, increasing capability when climbing stairs and inclines up to 45° and allowing traversal of extremely rugged terrain.

This command system is expandable, easier to use and allows the integration of the unmanned ground vehicle (UGV) with a wide range of digitally controlled accessories such as portable x-ray systems, chemical detection monitors and electronic counter measures (ECM) unit.

Vanguard™ Command and Control Unit (Allen-Vanguard) 1341912

Specifications
Width: 45 cm
Length: 104 cm
Height: 56 cm (stowed position)
Turning circle: own length, neutral turn
Operational weight: 58 kg
Speed: 0–2.25 km/h
(double with wheel kit fitted)
Number of cameras: 3 including PTZ colour camera (option for one extra – IR or disruptor)
Power supply: 24 VDC
Command options: Cable or wireless encrypted RF

Reach:
Vertical: 132 cm
Horizontal: 96.5 cm
Telescopic arm: 220 cm
Maximum lift: 8 kg with arm extended
Mission: up to 5 hours with change of battery, depending on mission

Status
In production and in service with the Royal Canadian Mounted Police.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

Wheelbarrow MK8 Plus II

Description
The Wheelbarrow MK8 was originally developed for the disposal of improvised explosive devices in Northern Ireland. MK8 Wheelbarrows are in service with EOD units around the world, including variants designed for mine clearance in the Falkland Islands and Bosnia.

The chassis unit houses the batteries and can be moved forwards or backwards to alter the centre of gravity. This feature greatly increases the vehicle's ability to negotiate steep slopes or stairs and to carry or tow heavy weights; with the boom retracted, up to 150 kg can be lifted. The two-speed gearbox allows fast approaches as well as slow, precise, final positioning. The vehicle can be operated using cables up to 150 m long, or via a radio link; it also features a two-way audio system.

The modular construction of the top hamper allows a wide variety of cameras, disruptors, weapons, manipulators and detection equipment to be mounted. Powerful electric actuators are used to elevate and extend the boom, with a further Modular Weapon Mounting System (MWMS) enabling a variety of equipment and accessories to be placed at almost any angle, including vertically up or down.

Additional features on the MK8 Plus II include the option of 200 or 500 m fibre optic cable, as well as a track retention system to increase the vehicle's rough-terrain capability. Batteries can now be charged while on the vehicle, or trickle-charged via the remote cable link. The new control system is digital, allowing proportional control of actuator speeds; joystick control is also available in place of the original switch system. The vehicle has been tested for international CBRNE deployment.

A number of accessories are available including: x-ray mounting kit, laser designator, ceramic cutter and modular weapon mounting system.

Wheelbarrow MK8 Plus II (Remotec UK) 0074340

Specifications
Width: 65 cm
Length
forward stance: 125 cm
rear stance: 135 cm
Turning circle: own length, neutral turn
Operational weight: 315 kg
Speed: 0–5 km/h
Gearbox: 2-speed
Number of firing releases: 7
Number of cameras: 4
Lighting: 2 x camera lamps (with dimmer control)
Camera mounting: 1 x pan unit, 1 x pan and tilt unit
Power supply: 24 V gel type batteries
Range
cable: 150 m
fibre optic: 200 m, 500 m optional
radio: 220 m urban, 1 km line of sight
Max reach with telescopic tube: 3.6 m to manipulator jaws
Lift capability
extended: 15 kg
retracted: 150 kg
Track geometry: 3 positions controlled remotely

Status
In production and in service with EOD units in numerous countries.

Contractor
Remotec UK Limited.

Wheelbarrow MK9 Plus II base station
(Remotec UK)
0074341

United States

All-purpose Remote Transport System (ARTS)

Description
The All-purpose Remote Transport System (ARTS) is a remotely operated medium-sized tracked prime mover, designed for mine clearance and explosive ordnance disposal (EOD). The skid-steer vehicle has a diesel engine, rubber tracks and two cameras which provide the remote operator with views to the front and back. Various attachments can be employed, including a backhoe, bucket, and brush cutter. The loader arms can be mounted on either the front or rear of the vehicle.

The vehicle, which is not armoured, has a four-cylinder diesel engine and can operate at a clearance speed of up to 11.2 km/h and clear 48 m²/h in light vegetation. ARTS has been certified for airdrop by the US armed forces, and can be transported by helicopter or fixed wing aircraft. The operator control unit is housed in an all-weather ruggedised case.

ARTS is based on the MD 70 vehicle produced by ASV Inc.

Specifications
Length without attachment: 2.89 m
Width without attachment: 1.67 m
Height without antenna: 1.98 m
Weight (basic vehicle): 2,948 kg
Remote control range: up to 1.9 km

Status
In service with US forces.

Contractor
Wesco Manufacturing Inc.

ANDROS F6A hazardous-duty mobile robot

Description
The ANDROS F6A is a high-speed, compact version of the ANDROS MARK V-A1 (see separate entry). It utilises the same articulated track design as the MARK V-A1 and the Mini-ANDROS II (see separate entry) to cross obstacles and navigate through rough terrain; the robot is fully sealed and weather resistant.

The standard manipulator system has a lifting capacity of 11 kg at full extension and a reach of 122 cm in front of the vehicle and 213 cm above the floor. Three low-light CCD cameras are fitted as standard: black/white arm camera with a fixed-position mount incorporating tilt adjustment, colour surveillance camera mounted on a pan-and-tilt mechanism and a black/white drive camera mounted in a fixed position on the front of the chassis. Variable intensity lights are attached to the surveillance and arm cameras. Optional video system features include motorised surveillance camera extender, night vision kit, picture-in-picture and head-mounted video display. A two-way audio system is mounted on the robot.

The vehicle is controlled by means of a briefcase-mounted control station; this can be used with optional radio control, fibre optic cable or portable cable reel. The control station includes a 12 V DC battery, a battery charger and the ability to operate on mains power.

A wide range of optional accessories are available including a shotgun, gas dispenser, and cable cutters.

ANDROS F6A hazardous-duty mobile robot
(Remotec Inc)
0074352

Specifications
Width: 44.5 cm (without wheels), 74 cm (with wheels)
Length: 132 cm
Height: 112 cm
Weight: 220 kg
Speed: variable 0–5.6 km/h
Ground clearance: 8.89 cm
Climbing ability
stairs: 45°
slope: 45°
ledge height: 46 cm
ditch width: 46 cm
Power supply: 2 × 30 Ah 12 V gel cell batteries on vehicle
Manipulator system (standard)
shoulder pivot: 210°
elbow pivot: 210°
Lift capability
full extension: 11 kg
45 cm reach: 27 kg
Reach
horizontal: 122 cm
vertical: 213 cm

Status
In production and in service.

Contractor
Remotec Inc.

ANDROS F6A briefcase-mounted control station (Remotec Inc) 0074353

ANDROS HD-1 mobile robot

Description
The Remotec HD-1 is the newest member of the ANDROS family and is suitable for a number of missions.

At full extension the ANDROS HD-1 mobile robot has a lifting capacity of up to 13.6 kg. The vehicle will operate in all types of environments including rain, sand, snow and mud. The HD-1 has the ability to reach under vehicles.

It is fitted with a colour surveillance camera (216:1 total zoom) mounted on a pan-and-tilt mechanism, a colour drive camera, black and white rear camera and 24 inch camera extender. The HD-1 can manoeuvre over obstacles 2.43 m tall.

There are three data links available for operator control of the HD-1: fibre-optic cable (deployed from the vehicle), radio control (wireless) and hard-tether cable.

Specifications
Width: 66.04 cm (with arm parked)
Length: 99.06 cm (with arm parked)
Height: 76.2 cm (with arm parked)
Weight:
(minus comm link) 90.7 kg
(minus quick release arm) 63.5 kg
Speed: 7 km/h
Operating time: Up to 4 hours
Rotation: 210° Shoulder Joint; 180° Wrist; 360° Gripper
Control link: cable or radio control
Max gradient climb: 30°

Remotec ANDROS HD-1 has an endurance of 4 hours (Northrop Grumman/Remotec) 1295358

Status
In production and in service.

Contractor
Remotec Inc.

ANDROS MARK V-A1 hazardous-duty mobile robot

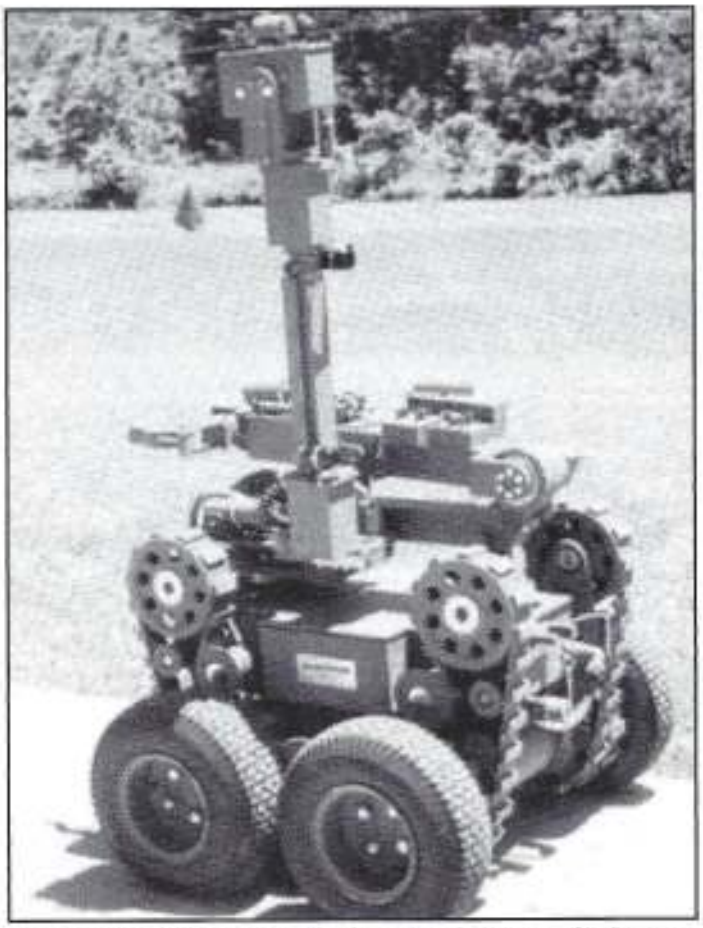
Description
The ANDROS MARK V-A1 is the largest and strongest robot in the Remotec range. Its high-speed and articulated tracks allow the vehicle to manoeuvre rapidly over rough terrain and obstacles, climb stairs and cross ditches. The vehicle is environmentally sealed to function in any weather conditions and in areas of high temperature/humidity; it can operate on almost any surface including grass, gravel, mud and sand.

The standard manipulator system has a lifting capacity of 27 kg at full extension and a reach of 162 cm in front of the vehicle and 233 cm above the floor. Three low-light CCD cameras are fitted as standard: a black/white arm camera with a fixed-position mount incorporating tilt adjustment, a colour surveillance camera mounted on a pan-and-tilt mechanism and a black/white drive camera mounted in a fixed position on the front of the chassis. Variable-intensity lights are attached to the surveillance and arm cameras. Optional video system features include colour drive or arm camera, infra-red cameras, picture-in-picture and head-mounted video display. The robot is fitted with a two-way audio system.

Two control station options are available: briefcase-mounted for increased portability or two-wheeled cart-mounted with controls, monitor, battery, speaker, microphone and 100 m cable reel. The control stations can be used with optional radio control or fibre optic cable and include a 12 V DC battery, a battery charger and the ability to operate on mains power.

A wide range of optional accessories are available including a shotgun, gas dispenser, and cordless drill.

For details of the latest updates to *Jane's Explosive Ordnance Disposal* online and to discover the additional information available exclusively to online subscribers please visit **jeod.janes.com**



The ANDROS MARK V-A1 is the largest and strongest in the range (Remotec Inc) 0074350

Specifications
Width: 72.4 cm (without wheels), 109 cm (with wheels)
Length: 115 cm
Height: 110 cm, 183 cm (camera equipment fully extended)
Weight: 358 kg
Speed: variable 0–5.8 km/h
Ground clearance: 13.46 cm
Climbing ability
stairs: 45°
slope: 45°
ledge height: 41 cm
ditch width: 61 cm
Power supply: 2 × 84 Ah 12 V spiral-cell batteries on vehicle
Manipulator system (standard)
shoulder pivot: 210°
elbow pivot: 210°
wrist pitch: 90°
wrist roll: continuous

Remotec ANDROS VA-1 has a maximum gradient climb of more than 45° (Northrop Grumman/Remotec) 1295360

Lift capability
full extension: 27 kg
45 cm reach: 45 kg
Reach
horizontal: 170 cm
vertical: 318 cm

Status
In production and in service.

Contractor
Remotec Inc.

ANDROS Wolverine hazardous-duty mobile robot

Description
The ANDROS Wolverine is six-wheel drive and is of a modular design to allow for rapid deployment, easy tool fitting and in-field maintenance. The vehicle will operate in all types of environments including rain, snow, sand and high humidity. A rubber track kit is available as an option.

The standard manipulator system has a lifting capacity of 27 kg at full extension and a reach of 162 cm in front of the vehicle and 254 cm above the floor. Three low-light CCD cameras are fitted as standard: black/white arm camera with a fixed-position mount incorporating tilt adjustment, colour surveillance camera mounted on a pan-and-tilt mechanism and a black/white drive camera mounted in a fixed position on the front of the chassis. Variable-intensity lights are attached to the surveillance and arm cameras. Optional video system features include colour drive or arm camera, infra-red cameras, picture-in-picture and head-mounted video display. The robot also features a two-way audio system.

Two control station options are available: briefcase-mounted for increased portability or two-wheeled cart-mounted with controls, monitor, battery, speaker, microphone and 100 m cable reel. The control stations can be used with optional radio control or fibre optic cable and include a 12 V DC battery, a battery charger and the ability to operate on mains power.

The robot can be fitted a wide range optional accessories including a shotgun, cordless circular drill or saw, mount assembly, window breaker assembly and cable cutter for L6 or L8 launchers.

ANDROS Wolverine fitted with optional rubber track kit (Remotec Inc) 0074351

Specifications
Width: 74 cm
Length: 147 cm
Height: 102 cm (with camera extender removed), 175 cm (with camera extender)
Weight: 367 kg
Speed: variable 0–3.25 km/h
Turning circle: 360° within vehicle length
Drive: 6 wheel, 24 V direct drive motors
Power supply: 24 V DC spiral-cell battery pack
Ground clearance: 13.97 cm
Manipulator system (standard)
shoulder pivot: 210°
elbow pivot: 210°
Lift capability
full extension: 27 kg
45 cm reach: 45 kg
Climbing ability: 45°
Reach
horizontal: 180 cm
vertical: 276 cm

Status
In production and in service.

Contractor
Remotec Inc.

Remotec ANDROS Wolverine has a curb clearance of 0.13 m
(Northrop Grumman/Remotec)
1295359

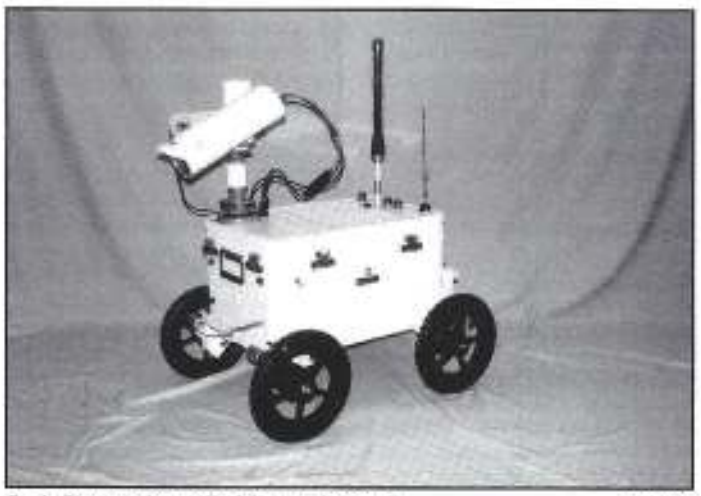
BARCS – Basic Remote Controlled System

Description
BARCS is the latest OAO Corporation Robotics Division product which provides a simple and low-cost platform to address a variety of remote sensing and improvised explosive device (IED) manipulation requirements. BARCS can be as simple as a line of sight cable controlled platform or can be incrementally grown to accommodate radio control, teleoperation, manipulators and sensors.

The BARCS control architecture allows ease of configuration to accommodate incrementally various manipulators, tools, and sensors (for example video, infrared, GPS, chemical/biological detectors) which can be installed by the customer with minimum effort. The system can be packaged for rapid deployment and ease of transport.

Specifications
BARCS – Basic Remote Controlled System
Weight: 36.24 kg without accessories
Max speed: 6.4 km/h
Payload capacity: 9.06 kg
Side tilt: 20°
Radio range: 800 m (urban), 2 km (open areas)

Status
In widespread use.



Basic Remote Controlled System (BARCS) 0084643

Contractor
OAO Corporation.

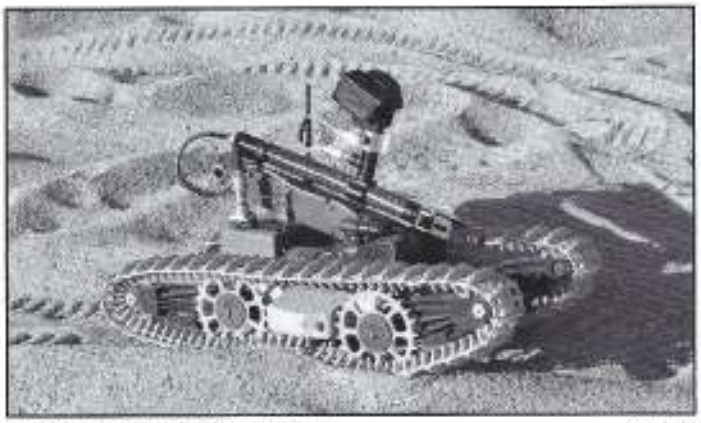
Dragon Runner SUGV

Development
The Dragon Runner SUGV (Small Unmanned Ground Vehicle) was based on a robot originally designed for the US Marine Corps. QinetiQ North America's Technology Solutions Group launched the new Dragon Runner UGV in September 2008. It can be reconfigured in the field for a number of applications including: Improvised Explosive Device (IED) disarmament, in-vehicle and under vehicle inspections, hostage barricade reconnaissance and negotiation, reconnaissance inside buildings sewers, drainpipes and caves, checkpoint security and perimeter security.

Description
The Dragon Runner is lightweight, weighing less than 20 kg. This makes it easily transportable and it can be carried by one person in a standard-issue pack. It is user friendly as no special tools required. The vehicle has the ability to have tracks added on for maximum mobility. A rotating shoulder, wrist and grippers can be incorporated for dexterity. The Dragon Runner can also be fitted with day and night pan/tilt/zoom cameras, motion detectors and listening capability.

To improve flexibility and range, the vehicle has field-changeable frequency capabilities by using either analogue or digital radio options. The operator control unit (OCU) has a quad-screen mode which can provide four simultaneous camera views or one individual view.

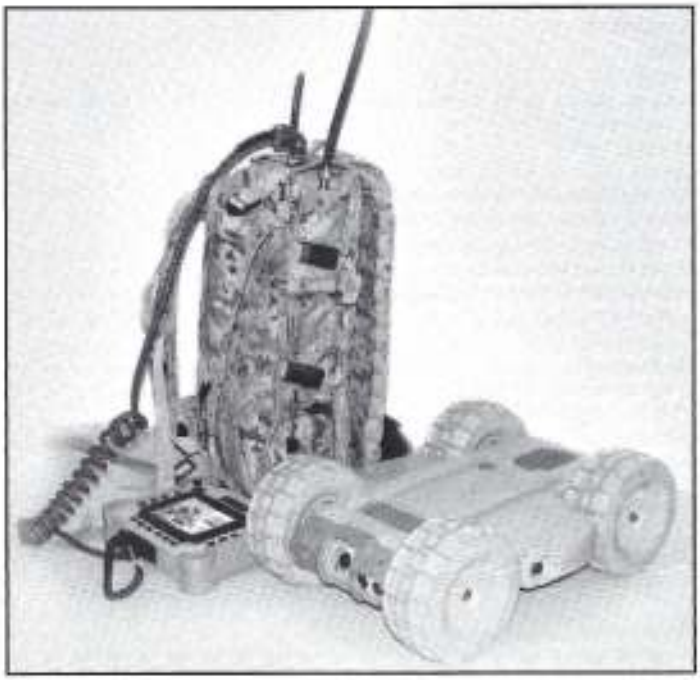
Specifications
Dragon Runner
Height: 0.2 m
Width: 0.38 m
Length: 0.84 m
Weight: 10.4 kg
Max speed: 16 km/h
Endurance: 4–6 h
Max gradient climb: 40°



Dragon Runner UGV (QinetiQ Ltd) 1336213

Dragon Runner UGV control unit (QinetiQ Ltd) 1296318

Curb clearance: 25.4 cm
Fording depth: 0.152 m
Max total payload: 9 kg
Battery type: XX-2590
Manipulator arm
Max lift capacity:
(extended) 2.27 kg
(unextended) 4.5 kg



Dragon Runner UGV kit (QinetiQ Ltd) 1334720

Max length: 0.6 m
Portable control station
length: 0.55 m
width: 0.15 m
depth: 0.17 m
Weight: 3.17 kg
Control link: Radio control
Line of sight control: 600 m
Frequency: 5 GHz

Status
Development complete. In service with USMC, US Army, special forces and SWAT and FBI teams.

Contractor
Foster-Miller Inc.
QinetiQ.

ForkBot

Description
ForkBot is a heavy lift, tele-operated, remote control vehicle and weapons platform based on a series of commercially available forklifts outfitted with a tele-operation kit or tethered fibre optic cable. It is rapidly deployable equipment for counter-terrorism and homeland security specifically designed to address the threat of large vehicle bombs. It can be used to interrogate and then remove an abandoned vehicle or large threat from a dam, tunnel, bridge, building front, or other high-risk area, and to breach the object as well as neutralise the threat. An onboard armament capability allows the remote firing of STI-initiated disrupters and counter charges. ForkBot can be used for both remote and manned operations, taking less than five minutes to switch modes.

Optional accessories include: solid tyres, fibre optic link, disruptors, sensors, blast protection, transport trailer and control vehicle.

Specifications
Lift capacity: forklift dependant (typically 4,500 to 16,400 kg)
Weight: forklift dependant (7,700 kg ForkBot provides 4,500 kg lift capacity)
Command range: 1,000 m (radio or fibre optic)

Status
In production.

ForkBot can be used to remove abandoned vehicles 1041298

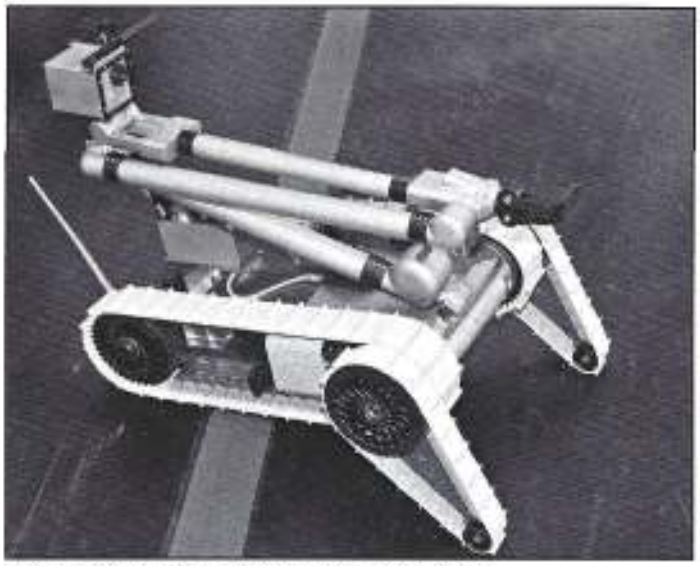
Contractor
Jackson and Tull (formerly QAO Robotics).

iRobot PackBot 510 with EOD Kit

Development
The iRobot PackBot with EOD kit was designed for use in bomb disposal (to identify and neutralize roadside bombs, car bombs IEDs/VBIEDs/UXOs), checkpoints (examines vehicles, packages and buildings to distinguish IEDs from harmless objects), inspections, explosives detection and route clearance. Designed to be used by army, marine corps, navy and air force EOD technicians.

Description
The PackBot 510 is a man-portable counter-IED and EOD robot. It features a set of polymer caterpillar tracks and an additional pair of caterpillar tracked 'flippers' at one end, which aid the robot in ascending stairs and manoeuvring across uneven surfaces.

The manipulator has eight degrees of freedom and a base that offers 360° rotation. It has a horizontal reach of over 2 m, and at full extension can lift 4.5 kg. The maximum load at a reduced extension is 13.5 kg. The gripper is able to open to an angle of 180°.



iRobot PackBot EOD remote operated vehicle (ROV)
(Jane's/Patrick Allen) 1345670

The system is equipped with a range of cameras. The surveillance camera has continuous pan and 220° tilt. It is a colour CCD with a 312 × zoom function and low-light capabilities. The wide-angle drive camera is mounted on the base unit. It provides forward, rear and downward views, and is also able to view the manipulator position. Two colour cameras provide a view of the head from the manipulator's second elbow. The vision and targeting head is equipped with cameras that provide the primary means for the operator's view of the robot's position and movement.

The unit is controlled via a portable command console that utilises a 'gamepad' style controller that interfaces with a command screen that shows the feeds from the robot's on-board cameras and displays sensor information. It has preset manipulator positions and a 3-D visualisation of the robot. Command is via either a radio-control system or fibre optic cable.

The PackBot 510 is equipped with the ICx Fido explosive detection system, which detects explosive vapours emanating from IEDs and other ordnance. These are then disposed of by the robot's on-board EOD equipment, which is primarily a disruptor; a range of equipment can also be attached to the system.

Variants
There are two variants of the PackBot 510, these include the iRobot PackBot 510 with First Responder Kit and the iRobot Small Unmanned Ground Vehicle (SUGV) Early.

Specifications
Width: 40.6 cm (flippers off), 52 cm (flippers on)
Length: 81.2 cm (flippers stowed), 101.6 cm (flippers extended)

PackBot 510 EOD robot control unit (iRobot) 1154661

Height: 40.6 cm (manipulator stowed), 221 cm (manipulator extended)
Weight (standard unit): 30.8 kg
Speed: variable 0–9.3 km/h
Power supply: 2 × 30 Ah 12 V gel cell batteries on vehicle
Manipulator system (standard)
shoulder pivot: 220°
elbow pivot: 340° (elbow 1), 340° (elbow 2)
Lift capability
full extension: 4.5 kg
maximum: 13.5 kg
Reach
horizontal: 203 cm
Command console
weight: 18.5 kg (with one battery)
dimensions: 45.7 × 37 × 46.9 cm (open)
screen: 26.6 cm, daylight readable
Operating duration: 3 h

Status
In production and in service. To meet urgent CENTCOM requirements, 225 Packbots have been delivered.

Contractor
iRobot Corporation.

Mini-ANDROS II hazardous-duty mobile robot

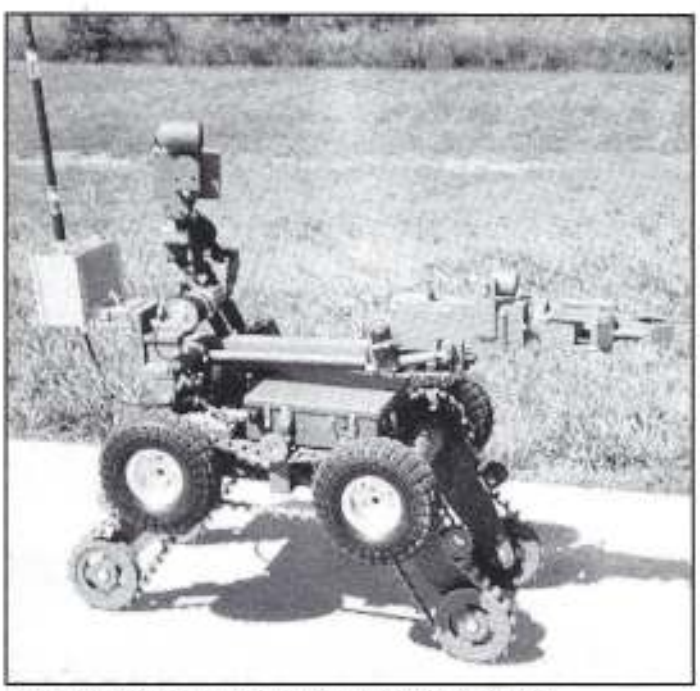
Description
The recently redesigned Mini-ANDROS II incorporates a 2 m reach and articulating track and wheel configuration. Its compact size allows it to manoeuvre in confined spaces and the modular design allows for rapid deployment and easy tool change.

Standard equipment includes a manipulator system with a reach of 114 cm horizontally and 220 cm vertically capable of lifting 7 kg at full extension. The standard video system includes three low-light CCD cameras: black/white arm camera with a fixed-position mount incorporating tilt adjustment, colour surveillance camera mounted on a pan-and-tilt mechanism and a black/white drive camera mounted in a fixed position on the front of the chassis. Optional features include a colour arm camera and head-mounted video display. The robot features a two-way audio system.

The vehicle is controlled by means of a briefcase-mounted control station; this can be used with optional radio control, fibre optic cable or portable cable reel.

A wide range of optional accessories are available including a shotgun, gas dispenser, and window breaker assembly.

Specifications
Width: 62 cm
Length: 135 cm
Height: 94 cm (camera extender deployed), 69 cm (camera extender folded down)
Weight (standard unit): 102 kg
Speed: variable 0–1.8 km/h
Ground clearance: 7.62 cm



Mini-ANDROS II articulating track and wheel configuration
(Remotec Inc) 0074349

Climbing ability
stairs: 45°
slope: 45°
ledge height: 41 cm
ditch width: 53 cm
Power supply: 24 VDC gel cell battery pack, 1 × 12 V battery in control station
Manipulator system (standard)
shoulder pivot: 60°
wrist pitch: 90°
wrist roll: continuous
Lift capability: 7 kg at full extension
Reach
horizontal: 114 cm
vertical: 220 cm

Status
In production and in service.

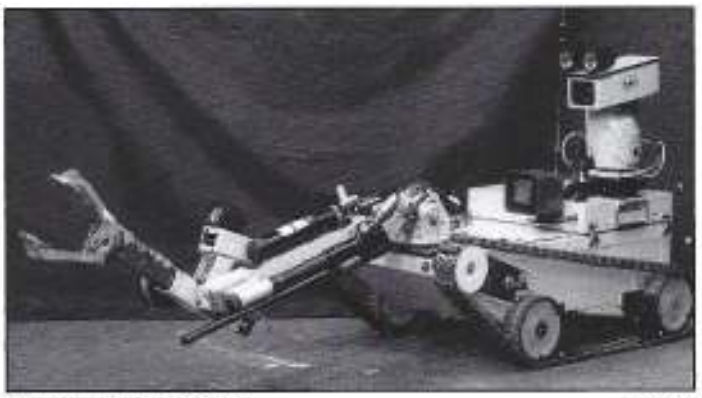
Contractor
Remotec Inc.

MPR-150 multipurpose robot

Description
This compact system provides a modular platform in a size that allows ease of transport and rapid deployment. The modular design allows the mounting of various manipulators, vision systems, sensors and accessories. Compact and lightweight, it can manoeuvre in restricted areas inaccessible to larger remote-operated vehicles. The short, broad stance of the track drive system assures stability in varied terrain, over obstacles and while ascending and descending stairs.

The six degrees of freedom arm provides the operator with the flexibility to address a variety of situations. The combination of the OAO control system and the standard two-camera vision system makes remote-control teleoperation missions simple and effective. Many options are available including laser-sighted shotgun and disruptors, X-ray, sensors, hydraulic door-breachers and remote two-car tow hooks.

Specifications
Weight (without accessories): 99 kg
Arm capacity
fully extended: 10 kg
retracted: 20 kg
Reach
vertical: 1.5 m
horizontal: 0.865 m
Max gradient: 45°
Side tilt: 40°



OAO MPR-150 EOD robot 0023359

Radio range
urban: 800 m
open areas: 2 km

Status
No longer in production. In service.

Contractor
Jackson and Tull (formerly OAO Robotics).

MURV-22 Robot System

Description
The MURV-22 is a low-profile, radio-controlled observation platform that provides video as well as audio information so the operator can see and hear in advance what and who he is going to be dealing with.

The system is equipped with a front-mounted black and white video camera with radio-controlled pan and tilt as well as a black and white back-up camera. Both cameras have radio-controlled lights. A two-way audio system incorporated into the MURV-22 enables the operator to hear conversation and other sounds in the vicinity of the robot; a hand-held radio set allows the operator to communicate through a speaker fitted to the robot.

Complete radio-control of the robot is provided by the Operator's Control Console.

Status
No longer in production. In service in the US.

Contractor
HDE International Robots, Inc, formerly HDE Manufacturing Inc.

MURV-100/100-S Robot System

Development
The MURV-100 was designed for use in Improvised Explosive Device (IED) scouting, removal and disruption, hostage negotiations, bomb disposal, SWAT, HAZMAT, entry into dangerous sites and spaces, plus scouting and investigating chemical, biological and radiation threats.

Description
The MURV-100 (Multi Use Robot Vehicle) is a compact modular tele-operated robot system. The system is man-portable and can be operated with the included radio-control link or with an optional fibre optic cable. Three video cameras provide the operator with image feedback from several different perspectives: a black and white pan-tilt camera on the front of the vehicle, a full colour camera on the 'wrist' and a black and white back-up camera. The system is powered by quick-change battery packs that provide up to four hours of operation and are recharged using the supplied battery charger. With the manipulator arm removed the platform is only 120 mm high and can manoeuvre in very confined spaces.

All of the wheels are driven enabling the robot to operate in a wide range of rough terrain, to climb inclines up to 40°, traverse wide ditches and to climb curbs and some stairs; a set of 16.5 cm wheels are available. The included manipulator has five degrees of freedom; this can be increased to seven degrees of freedom with optional equipment. The arm, which weighs less than 7 kg, can extend from 15 cm to more than 150 cm. A load of up to 22 kg can be lifted and over 59 kg dragged. A 'weapons firing circuit' provides a fail-safe means of remotely controlling various optional weapons or other special functions on the robot.

Many standard accessory items are available including: disruptor arm, disruptor trailer, audio communication system, extra cameras with zoom lenses, arm turntable, arm base pitch assembly, X-ray carrier, fibre-optic control system, shaped charge placing system and sensor interface modules for detecting and analysing agents of weapons of mass destruction.

The MURV-100-S has the same basic features as the standard model but has the ability to deploy a variety of sensor systems to monitor and detect NBC threats. These are mounted on up to four sensor interface modules which provide power for the attached systems; they can also be fitted with a radio system that transmits data to a computer station connected to the command station.

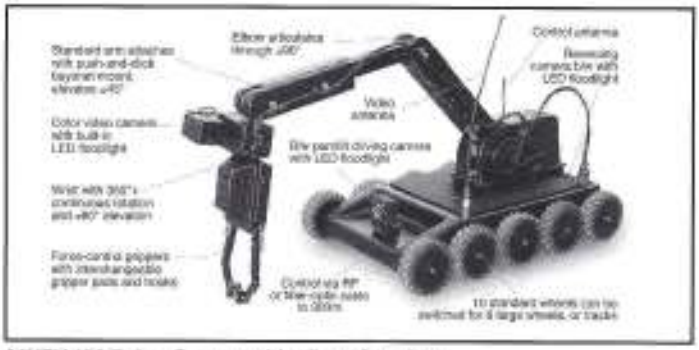
Specifications

	without an arm	w/standard arm held horizontal	w/standard arm held vertical	w/high-rise arm held vertical
Length: (to tip of gripper)	58 cm	124 cm	58 cm	58 cm
Width:	43 cm	43 cm	43 cm	43 cm
Height: (to tip of gripper)	11 cm	30 cm	124 cm	115–235 cm*
Height: (w/elevator block)	42 cm	61 cm	155 cm	145–265 cm*
Weight:	14 kg	23 kg	23 kg	28 kg

Power supply: 12 V sealed gel-cell batteries
Operating temperature: –20° to +75°C
*high-rise arm extends and shortens

Arm joints	standard arm	high-rise arm
Movement at shoulder:	0° to 90°	+15° to –15°
Bending at elbow:	+90° to –90° (180° total)	no elbow
Wrist pitching up-down:	+90° to –90° (180° total)	+90° to –90° (180° total)
Wrist rotation:	continuous in both directions	continuous in both directions
Turntable rotation right-left:	+100° to –100°	+100° to –100°
Lifting power:		
(arm near vertical)	22.7 kg	21.1 kg
(arm horizontal)	5.5 kg	n/a

Drive	standard wheels	large wheels	track
Wheel diameter:	11.5 cm	15.24 cm	n/a
Max speed:	1.1 km/h	1.4 km/h	0.4 km/h
Height of max traversable step:	22 cm	23 cm	26 cm
Width of max traversable ditch:	31 cm	32 cm	36 cm
Max lateral slope (arm low):	35°	35°	45°
Inclines (dry surface):	50°	50°	50°



MURV-100 Robot System with elbow function
(HDE International Robots, Inc) 1298771

Status
In production. Since 1994, over 40 systems have been delivered across the United States and the world. In service with the US Air Force, Navy, FBI, ATF, NASA, enforcement agencies worldwide and the Slovenian and Turkish armies.

Contractor
HDE International Robots, Inc, formerly HDE Manufacturing Inc.

ODIS-T3

Development
The ODIS-T3 (Omni-Directional Inspection System) is a multi-use modular robotic system with on-road and off-road capabilities. Applications include: vehicle inspection and deterrent at security checkpoints, customs/border patrol entry point inspections, contraband inspection, DoT safety inspections, airport security and Military/Commercial EOD support.

Description
The ODIS-T3 enables tele-operated video inspection of vehicle undercarriages and interior compartments to include the following scenarios: random or routine video vehicle inspections at fixed or hasty checkpoints, stand-off inspection of vehicles or buildings during security threat situations and remote surveillance.

The ODIS-T3 is of a rugged electro-mechanical design and has the capability to carry multiple payloads. It includes an off-road wheel package installed for operation in rough terrain, a high quality pan/zoom camera, is weatherproof and has 2-way audio communication. The vehicle has an omni-directional drive system which provides superior manoeuvrability.

A wireless video/audio can be transmitted to the operator at a stand-off distance of up to 100 m. The vehicle has a modular payload interface that provides power and data communications for prospective sensors, including: chemical sniffer, infrared thermal camera, radiation monitor and explosive detection sensor.

An optional manipulator arm is available which is capable of supporting a disrupter. There is also the option of an extendable camera mast payload. If required, the wheel nodes and electronics can be replaced in the field.

Specifications
Weight: >50 lb
Operating duration: 2–3 h
Set up and deployment time: 5 mins
Ground clearance: 5 in

Status
In production.

Contractor
Kuchera Defense Systems.

R500e Robot

Development
The R500e was designed to combine speed, functionality, power and performance and priced for mass distribution. In military applications, it can function as a mechanical point man on patrol, working ahead of troops, seeking out danger and when it is found, it can help to reduce the threat by deploying a charge up to 35 pounds on a disposable trailer. Applications include: law enforcement, first responder and homeland security missions. The R500e is designed to be 'eyes and ears' on the ground. It can bring back real-time images and intelligence from operations. For plant and port security applications, the robot can patrol, use fixed and mobile surveillance, and manoeuvre in small spaces to provide visual security. Further functions of the R500e can include reconnaissance and surveillance, threat reduction, and a disposable trailer (payload up to 11.34 kg) to destroy Improvised Explosive Devices (IED) and other threats.

Description
With the extended battery life, and a run time of up to eight hours, the operator can continue the mission without frequent interruptions to recharge batteries.

Key features of the R500e include: reusable robot with disposable trailers for threat reduction and long range (up to 305 m). The R500e is fitted with two cameras: a fixed drive camera that becomes the 'eyes of the operator' and a pan and tilt camera that moves up and down, and in any direction. Infra-Red (IR) capability provides the operator with night vision and low light visibility. It has a six inch display designed for bright daylight operation and also a high quality Heads Up Display (HUD) for hands-free viewing. The video is black and white for optimum resolution and the video output cable allows for camcorder recording.

The utility bed on the robot allows for carrying rapid coil, supplies and other items. The trailer can also be used for transporting items other than a charge. The robot is lightweight and weighs only 11.3 kg. The operator controls consist of an easy-to-use joystick. Both the robot and Operator Control Unit (OCU) come in hard cases for safe transportation. The one-way audio transmits sound back to the operator.

Heavy duty shock absorbers are designed to last for an extended period of time in the field, and provide the capability to carry a sizeable load. The foam-filled tyres on the robot provide added grip and manoeuvrability, while the 45 cm wide wheel base provides added stability in rough terrain.

Specifications
Length:
(R500e) 58 cm (23 in)
(trailer) 45 cm (18 in)

The R500e is operational in day or night
(AMTI) 1299291

The R500e deploying a counter-charge (AMTI) 1299290

Width:
(R500e) 46 cm (18.5 in)
(trailer) 30 cm (12.2 in)
Height:
(R500e) 68 cm (27 in)
(trailer) 18 cm (7.2 in)
Range: 305 m (1,000 ft)
Max speed: 40 km/h (25 mph)
Weight: 11.34 kg (25 lb)
Width:
(wheel base) 46 cm (18 in)
Battery type: Lithium-Ion Polymer
Battery life: up to 8 hours (depending on terrain/operator)
Transmission: 2.4 GHz digital

R500e robot (AMTI) 1299292

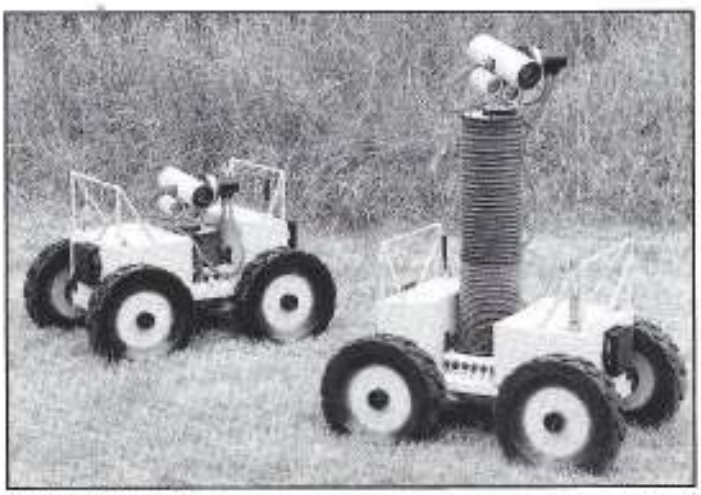
Status
In production.

Contractor
AMTI, an operation of SAIC.

RECORM robot

Description
The RECORM system is a small, lightweight surveillance platform for use in EOD or tactical situations. The Kevlar chassis ensures strength while minimising weight. Joystick control for both the drive and pan/tilt facility provide ease of operation. The system features interchangeable cameras for both colour and low-illumination situations. An onboard sensor capability provides sensor readout and alarms to the operator via video-overlay circuitry. The platform incorporates a design that allows decontamination after use in NBC environments. An intensive integrated logistics support effort conducted throughout the design process has resulted in an extremely reliable and maintainable configuration. The many accessories include a fibre optic deploy/retract system which can replace radio control for situations which require stealth or minimised RF signatures. The RECORM has been approved for US joint service EOD use.

Specifications
Weight: 46 kg (without accessories)
Payload capacity: 14 kg
Speed: 0–4.8 km/h
Max gradient: 40°
Side tilt: 30°
Radio range
urban: 800 m
open areas: 2 km
Fibre optic range: 650 m



QAO RECORM robots 0053786

Status
No longer in production.

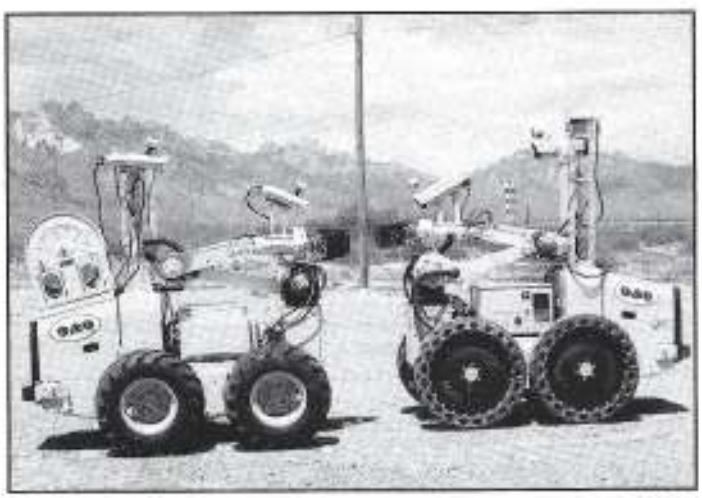
Contractor
Jackson and Tull (formerly QAO Robotics).

Remote All-Terrain System (RATS)

Description
Based on a commercial-off-the-shelf skid loader, RATS provides a robust, all-terrain platform for heavy-duty, teleoperation tasks. The vehicle's 30 hp diesel and hydraulic drive allow manoeuvring in a variety of hostile terrains that would immobilise most standard vehicles. The three-section, six degree of freedom (DOF) arm allows dexterous manipulation of up to 90.4 kg (200 lb) objects. The standard system consists of the RATS mobility platform modified for remote control, a six DOF arm/gripper combination, remote-control electronics, two cameras for observing drive/manipulator operations, RF and cable control, portable controller, video monitor, and support accessories.

The platform's hydraulic, electrical, and control electronics are oversized to accommodate the addition of a variety of accessories or user-specified subsystems. Applications include police/security, EOD, HAZMAT, firefighting and environmental remediation.

Specifications
Weight: 1,820 kg
Payload capacity: 91 kg



RATS 0023360

Reach: 244 cm
Towing capacity: 1,140 kg
Max gradient: 30°
Side tilt: 20°
Radio range
urban: 800 m
open areas: 2 km

Status
No longer in production. In service.

Contractor
Jackson and Tull (formerly OAO Robotics).

Remotec® Robotic Voice Control RoVoCon

Description
The RoVoCon is a voice command and control system for robotic platforms and is compatible with existing Remotec Hazardous Duty Robots (see separate entries). This robust voice control interface provides semi-automatic and hands-free operation including robotic arm deployment, mobility functions and camera functionality.

RoVoCon is based on a speech recognition application developed by INTECS International Inc.

Status
In production.

Contractor
Remotec Inc.

Talon HazMat second generation robot

Description
The Talon HazMat second generation robot has been developed to fulfil the operational requirements of Police forces and other first responders. In order to accomplish higher versatility and adaptability than its older versions, the robot has been re-engineered and is now capable of hosting approximately seven CBRN sensors on its platform.

The Talon HazMat was displayed for the first time at the beginning of 2007 at the Unmanned Systems Capabilities Conference (USCC), supported by the Joint Ground Robotics Enterprise (JGRE) and the Technical Support Working Group (TSWG) in Nashville, Tennessee, United States.

In 2007, the robot undertook the Disaster City Exercise in the National Institute of Standards and Technology (NIST) and has been further tested by the Armament Research Development and Engineering Centre (ARDEC), US.

Although not confirmed yet, an upgraded configuration of the Talon Hazmat robot designated as Talon Generation IV HazMat robot has been purchased in September 2008 by the US Military Academy (USMA), West Point.

The Talon HazMat follows a 'plug-and-play' principle which is sustained by the Joint Architecture Unmanned Systems (JAUS) software, while allowing the multiply integration of the seven sensors onto a user-friendly quick-release platform.

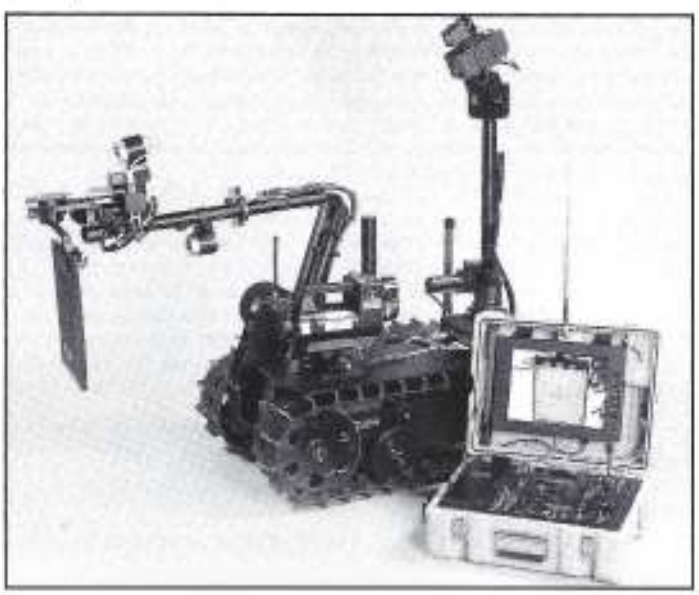
At the operator control unit, a person digital assistant (PDA) includes audio and visual alarms which are released in case of a mounted sensor exceeding its preset limits, providing the operators with the potential of concentrating mainly on the manoeuvrability of the Talon rather the constant monitoring of the sensors.

Data stemming from the mounted sensors are linked with the PDA which offers an initial assessment of the area under inspection for CBRN threats prior the deployment and possible exposure of the personnel.

The following sensors are mounted on the Talon HazMat:
- Smiths APD 2000 chemical detector
- Chem Sentry 150C produced by BAE Systems
- Canberra AN/VDR-13 beta and gamma radiation monitor
- Draeger Multiwarn II industrial gas detector
- RAE MultiRAE industrial gas detector
- Nomadics Fido explosives detector
- Raytek Target temperature probe.

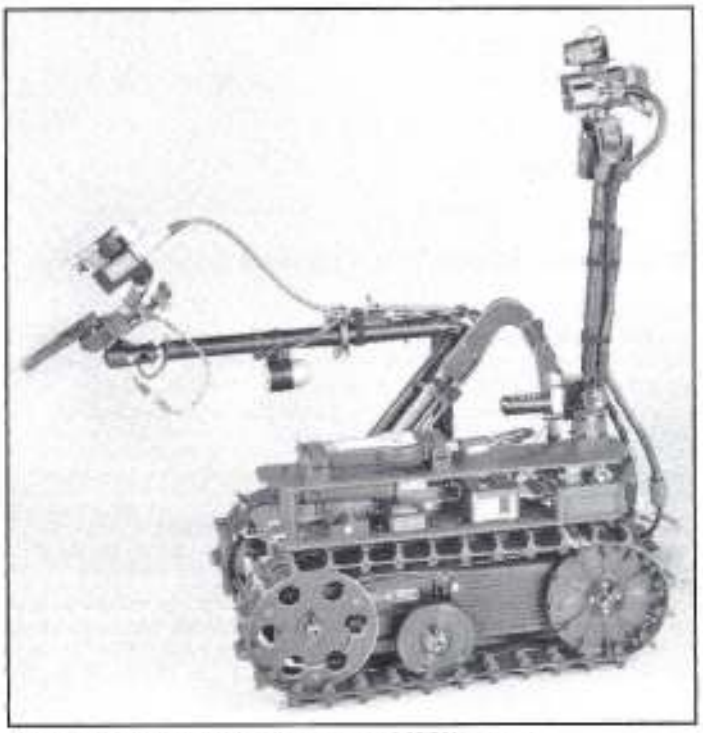
Specifications
Talon HazMat second generation robot
Height:
(arm stowed) 0.42 m
(arm extended) 1.3 m
Width: 0.57 m
Length: 0.86 m
Weight: 52 to 71 kg
Max speed: 6.6 km/h
Endurance: 4.5 h
Max gradient climb: 43° on stairs and 45° slide slope
Ground clearance: 0.07 m
Manoeuvrable speed: 8.3 km/h
Manipulator arm
Max lift capacity:
(extended): 4.5 kg
(unextended): 11 kg
Gripper max length: 0.15 m
Gripper max strength: 76.2 cm/kg
Portable control station:
(length) 0.48 m
(width) 0.40 m
(depth) 0.22 m
Weight: 15 kg

Talon HazMat robot tested in the Disaster City Exercise
(Qinetiq – Foster Miller) 1334482



The Talon IV HazMat robot variant with its x-ray kit
(Qinetiq – Foster Miller)
1334488

Control link: Radio Frequency (RF) or fibre optic link
Powerplant:
Battery life: 2.8, 300 W/h
Battery type: Two Lead Acid or Lithium Ion (optional)
CBRN sensor package
Smiths APD 2000 portable chemical agent detector
Technology: Ion Mobility Spectrometry
Agents detected: GA, GB, GD, VX, HD, Lewisite and riot control agents
Sensitivity:
V agents: 4 ppb (parts per billion) in 30 s
G agents: 15 ppb in 30 s
H agents: 300 ppb in 15 s
Lewisite: 200 ppb in 15 s
Power supply: 6 standard batteries
Size: 0.10 × 0.09 × 0.28 m
Weight: 3 kg
Operational temperature: –5°C to +52°C
Canberra AN/UDR-13 beta and gamma radiation monitoring instrument
Radiation measuring range: 0.001 cGy/hr to 999 cGy/hr
Energy range: 80 keV to 3 MeV
Dose measuring range: 0.001 cGy to 999 cGy
Size: 0.10 × 0.06 × 0.2 m
Weight: 270 g
Chem Sentry 150C detector
Technology: Surface Acoustic Wave (SAW), Electro-Chemical Cell
Agents detected: VX, G-Series, HD, Lewisite, AC, CK blood agents
Exposure response time max:
V agents: <30 s
G agents: <30 s
H agents: <10 s
Blood agents: <10 s
Lewisite: <10
Power supply: Rechargeable BA-380 NiMH cells
Size: 0.10 × 0.17 × 0.03 m
Weight: 0.9 kg
Operational temperature: –32 to +49°C
Dräeger™ Multiwarn II gas detector
Gases detected: CO, H_2S, O_2 and Combustible gases (depending on the sensors attached)
Size: 0.55 × 0.11 × 0.65 cm
Weight: 1 kg
RAE MultiRAE industrial gas detector (Plus/IR)
Gases detected: Oxygen, Combustible gases, Volatile Organic Compounds (VOCs), CO, H_2S, SO_2, NO, NO_2, CL_2, HCN, NH_3, PH_3
Size: 1.8 × 7.6 × 4.8 cm
Weight: 0.454 kg



Talon HazMat robot with all the mounted CBRN sensors
(Qinetiq – Foster Miller) 1334487

Status
In production. A variant of the Talon HazMat robot has been acquired by the US Military Academy (USMA), West Point. Further information not available.

Contractor
Foster-Miller Inc.
Smiths Detection
BAE Systems
RAE Systems
Dräger Safety AG
Canberra Dover Inc.

TALON robot

Development
TALON is a powerful, lightweight, versatile, remote-control vehicle designed for missions ranging from EOD, reconnaissance, communications, sensing, security, defence, counter IED, and rescue. Its large, quick-release cargo bay accommodates a variety of sensor payloads making it particularly suitable for this wide range of mission requirements.

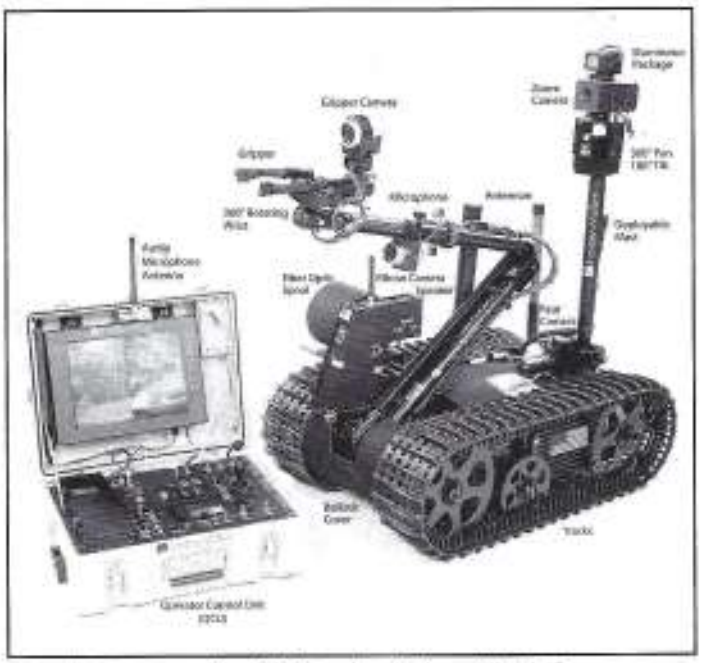
Description
TALON is amphibious and can operate in all weathers and at night. It can also operate over most forms of terrain. It can be controlled from an operator control unit, the joystick controls being intuitive.

TALON has seven speed settings and, weighing up to 64 kg depending on the mission, is easily transportable. It has a self-righting capability and long battery life. Operating in the EOD role, the robot has been in active military service since 2000, when they were first used in Bosnia for the safe movement and disposal of live grenades. They were subsequently used at Ground Zero in search and recovery efforts following the September 11 attack on the World Trade Center, and in Afghanistan, Kuwait and Iraq. TALON robots have, according to the manufacturer, completed more than 20,000 EOD missions in Iraq and Afghanistan.

A second-generation TALON hazmat robot has been developed for use in the NBC detection role; it is able to accommodate up to seven sensors via plug-and-play interfaces. The system also features visual and audio alarm functions via a PDA located alongside the robot control unit.

The company has developed an armed version of the robot known as SWORDS (Special Weapons Observation Remote Reconnaissance Direct action System), it is fitted with a remotely operated weapon station and can accommodate the M240, M249 and M109 Barrett .50 calibre. The ability to incorporate a 40 mm grenade launcher and M202 anti-tank rocket system is under evaluation.

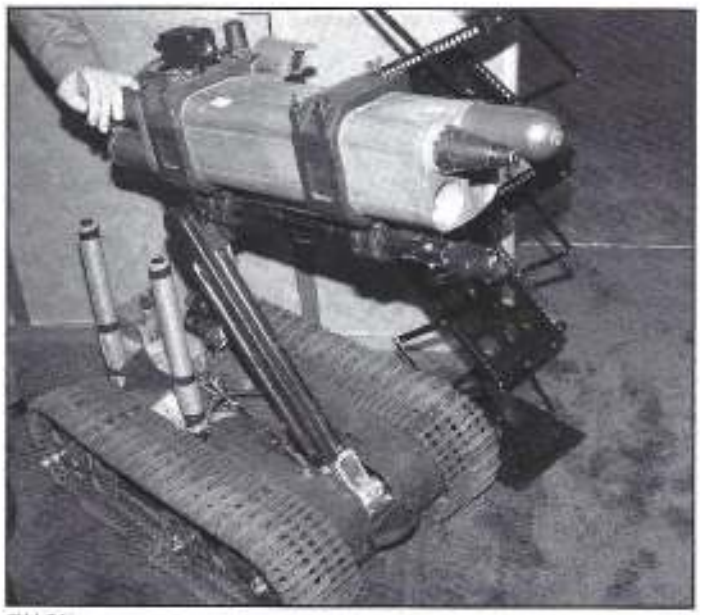
Specifications
Vehicle dimensions
Height, arm stowed: 42.7 cm
Height, arm extended: 1.3 m
Width: 57.2 cm
Length: 86.4 cm



A detailed account of the TALON main robotic mobile platform
(Foster-Miller) 1334501

Horizontal reach: 1.3 m
Ground clearance: 7 cm
Weight: 52–71 kg, depending on mission configuration
Speed: Variable speed settings, up to 8.3 km/h
Robot battery life: Up to 4.5 hrs at typical operational speed with lithium ion optional battery
OCU battery life: Up to 4 hrs with lithium ion optional battery
Amphibious capability: 27 m depth
Video: 3 infra-red illuminated cameras and auto-focus colour zoom camera

TALON EOD robot control unit (Jane's/Patrick Allen) 1150058



TALON remote operating vehicle used by the US Army for EOD clearing (Jane's/Patrick Allen) 1029404

Communication: Digital/analogue as standard provides a 500–800 m line-of-sight range, an optional high gain antenna extends the range to 1200 m, and there is a fibre-optic cable of 300 m or 500 m length
Payload capacity: 45 kg
Tow capability: 680 kg
Drag capacity: 113 kg (with Gripper)
Arm lift capacity:
(full extension): 4.5 kg
(max capacity): 11 kg
Side slope: 45%
Standard OCU:
dimensions: 48.3 (l) × 40.6 (w) × 22.9 (h) cm
weight: 15 kg

Status
In production and in service. Operating in the EOD role, the robot has been in active military service since 2000, when they were first used in Bosnia for the safe movement and disposal of live grenades. They were subsequently used at Ground Zero in search and recovery efforts following the September 11 attack on the World Trade Center, and in Afghanistan, Kuwait and Iraq. TALON robots have, according to the manufacturer, completed more than 20,000 EOD missions in Iraq and Afghanistan. SWORDS is currently deployed in Iraq.

Contractor
Foster-Miller Inc.
QinetiQ Ltd.

TALON Explosive Ordnance Disposal robot (QinetiQ Ltd) 1165210

Teleoperated Ordnance Disposal System (TODS)

Development
Based on a commercial-off-the-shelf skid loader, the TODS allows an operator to remotely detect, excavate and transport unexploded ordnance (UXO) to a safe area.

Description
The system has proved to be an effective tool for mine remediation during peacetime operations. TODS consists of a remote-controlled, teleoperated skid loader which carries a manipulator, excavation bucket, compressed air excavation system, mine/metal detector, vegetation cutter and differential GPS. The system can accommodate user-defined accessories or options to tailor the system's utility towards specific applications. TODS can be deployed from a control site established a safe distance from the operations area, which can be up to 1,000 m. Extended range options are available.

Specifications
Weight: 1,808 kg
Payload capacity: 100 kg
Reach: 330 cm
Towing capacity: 1,140 kg
Max gradient: 30°
Side tilt: 20°
Radio range
urban: 800 m
open areas: 2 km
Wire link: up to 914 m
Speed: 0 to 8 km/h
Power source: 30 hp diesel engine
Operating time: approx 10 h

TODS 0053787

Status
In service.

Contractor
Jackson and Tull (formerly OAO Robotics).

TR-2000 robot system (MAX)

Description

The TR-2000 enhanced tactical robot, named 'MAX', is a low-cost, lightweight, radio-controlled vehicle designed to perform human-like operations in hazardous environments. MAX can operate remotely from distances over 305 m, although range varies with terrain and atmospheric conditions. With the manipulator arm attached, MAX weighs less than 20 kg and the vehicle can be configured to pass under openings (such as cars) less than 12 cm high and can reach heights of up to 163 cm.

The TR-2000 Robot System is easy to transport and deploy, simple to operate and maintain, and comes with many standard features. The manufacturer claims that this is a safe, reliable and efficient vehicle for performing missions in dangerous situations.

HDE Robotics Group robots are used by the US Air Force, ATF, FBI, NASA and fire, police and military emergency response teams throughout the United States and overseas.

Specifications

Chassis
- length: 58.4 cm
- width: 43.2 cm
- overall length with arm extended: 124 cm

Weight
- vehicle only: 14 kg
- complete with manipulator: 20 kg
- control panel: 4.1 kg

Lifting capacity
- arm retracted: 13.6 kg
- at max extension: 4.5 kg

Operating time: typically 2–4 h, dependent on workload

Control system

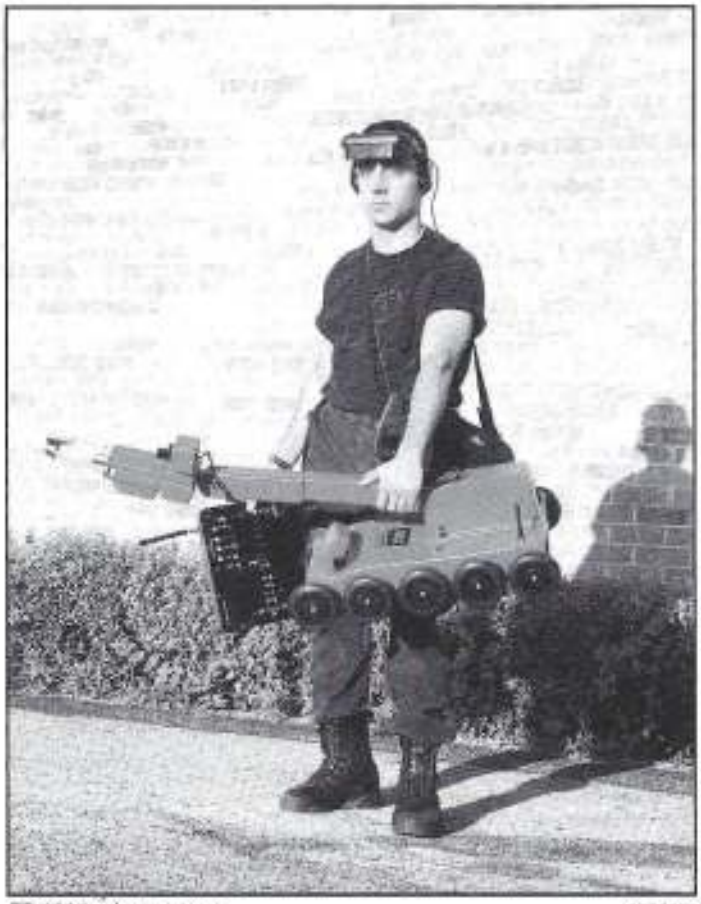
radio control: standard, wireless system

Range
- cable control: 91 m (fibre optic cable standard length)
- radio control: 914 m

remote link: 100 yd (control wire from console to remote transceiver – robot is wireless)

Status

No longer in production. In service in the US.



TR-2000 robot system 0005097

Contractor

HDE International Robots, Inc, formerly HDE Manufacturing Inc.

VEHICLES: SPECIALIST AND PROTECTED

Germany

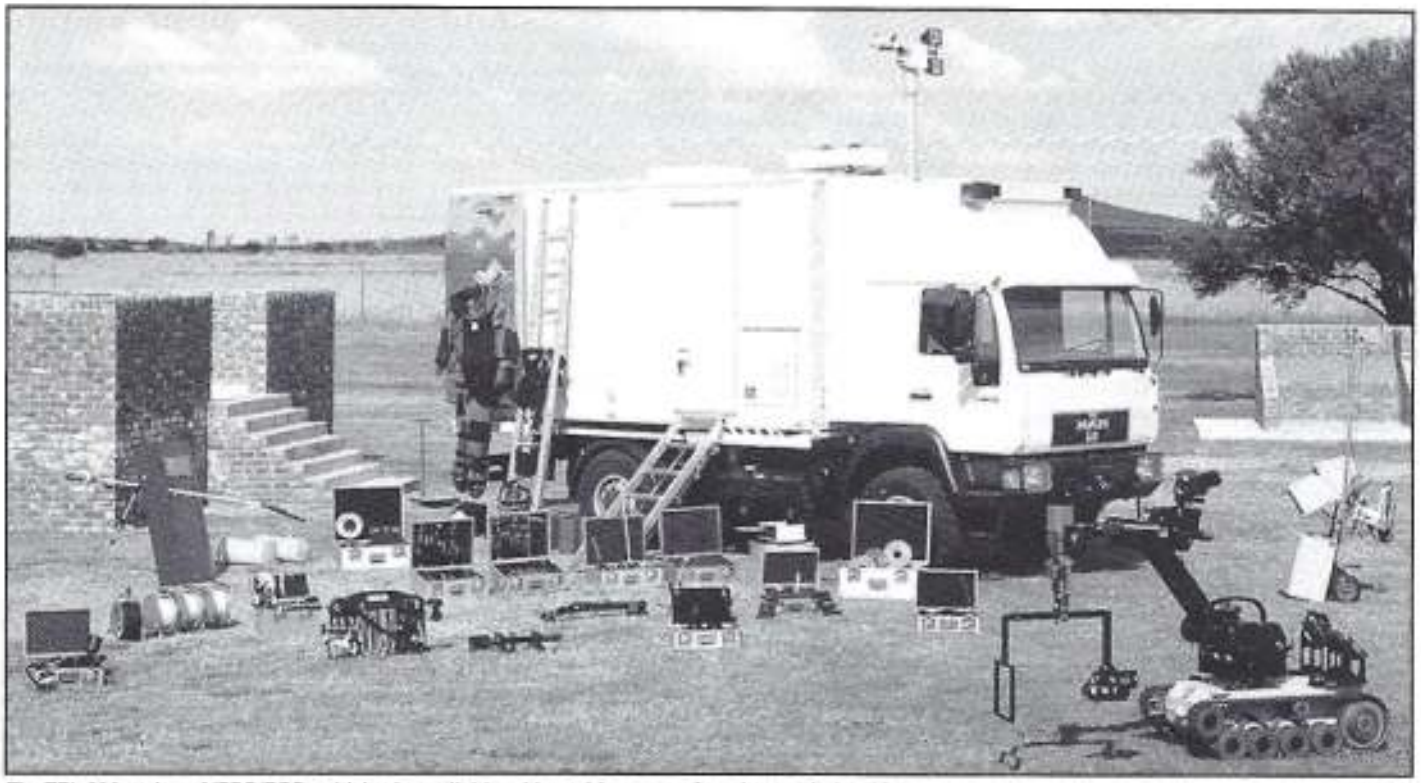
TEL600 series vehicles

Description
The TEL 600 series is a family of vehicles designed for locating, identifying and neutralising improvised explosive and incendiary devices, as well as for carrying out forensic operations and investigative analysis.

The series ranges from the Rapid Response Vehicle, a small and fast 4 × 4 vehicle enabling immediate action to be taken at the crime scene, to medium-sized vehicles specifically designed for a search and detection role, as well as fully equipped improvised explosive device disposal (IEDD) vehicles weighing 15 tons or more.

Status
Available. In service with the following countries Afghanistan, Argentina, Denmark, Germany, Indonesia, Jordan, Kazakhstan, Kuwait, Nigeria, Qatar, Romania, Saudi Arabia, Turkmenistan, UAE and Uzbekistan.

Contractor
telerob Gesellschaft für Fernhantierungstechnik mbH.



The TEL 600 series of IEDD/EOD vehicles is available with a wide range of equipment (telerob) 0123503

South Africa

Casspir family of vehicles

Description
Creation of the Casspir Mk I armoured personnel carrier (APC) followed the development of the South African Mine-Protected Vehicle (MPV), itself based on a Bedford truck chassis. In designing all three models of the Casspir, Mk I, II and III, particular attention was paid to the threat of landmines and, although the family of Casspir vehicles has been designed for and deployed in wide-ranging roles, including APC, recovery vehicle, tanker and weapons platform, specialised demining versions are also available. These include acting as the sensor vehicle for the MEDOS system and being the basis for Denel's Vehicle Array Mine Detection System (VAMIDS). In the Mechem mineclearing vehicle configuration, a set of mine-detonating steel wheels exert sufficient ground pressure to detonate anti-tank mines and allow the Casspir to continue moving after a detonation, and the rear compartment of the Casspir can also be modified to accept the containerised Plofadder 160AT rocket-propelled mineclearing system; in this latter configuration, the Plofadder system is slid onto the Casspir and launched through the open roof. For mineclearing in rocky terrain, the Casspir can accommodate a trailer with steel disc rollers and hydraulic lifting arm.

According to the manufacturer, field repair times to the vehicle after a single anti-tank mine, the Russian TM-57 or equivalent, detonation are between 1 and 2 hours; after a multiple mine detonation, repair

Casspir armoured personnel carrier 0056157

Casspir armoured personnel carrier
(BAE Systems, Land Systems South Africa – OMC) 0074810

time extends to between 8 and 12 hours. The practical limit to this mine protection is a mine or mines detonation equivalent of between 18 and 20 kg of TNT/RDX. Several thousand Casspirs are currently in service in various countries.

The Casspir mine-protected personnel carrier has been deployed in various theatres of operations ranging from conventional, counter-insurgency and peacetime demining to law enforcement and riot-control situations.

The Casspir hull consists of a welded all-steel monocoque capsule to which leaf-spring suspension is attached and within which the main automotive and other components and systems are housed. The design offers maximum protection to both occupants and main components and facilitates rapid field repair. In standard configuration, Casspir has two pneumatically operated rear doors and a partially open roof with hatches above the driver and co-driver's positions. A fully armoured roof with hatches is available as an option. Casspir is equipped with a Mercedes Benz OM 352 A engine and a manual five-speed transmission delivering drive to all four wheels and producing a maximum speed of 90 km/h.

Status

In service. As well as serving in South Africa, Casspirs are believed to have been delivered to Angola, the DRC, Djibouti, India, Mozambique, Namibia, Nigeria, Peru and Uganda.

Contractor

BAE Systems, Land Systems South Africa – OMC.

Mamba family of vehicles

Description

Only a few production vehicles of the original Mamba Mk 1 were ever built but between 1993 and 1997 a total of 653 Mamba Mk 2 vehicles, taller than their predecessors and with 4-wheel drive, were manufactured for the domestic and export markets. As well as its primary intended role of armoured personnel carrier, the Mamba's projected roles include command post, recovery vehicle and logistic support.

The Mamba has an all-welded V-shaped monocoque hull with large windows for excellent all-round vision, a large rear door and eight outward-folding roof hatches. Based on the Unimog 416, it has a 92 kW, six-cylinder diesel engine and four-wheel drive. Power-assisted steering and a transmission with eight forward and four reverse gears give the Mamba excellent manoeuvrability and cross-country capability. The passenger compartment and windows are protected against 7.62 mm NATO ball ammunition, while the hull can withstand a single TM-57 anti-tank mine explosion under any wheel or beneath the centre of the vehicle.

This mine-protected 11-seater troop carrier can therefore transport demining personnel and equipment over high-risk areas and rough terrain.

The Mamba Mk 3 is an upgrade for the SANDF and includes additional ballistic protection, smaller armoured windows, improved braking, the relocation of the external fuel tank such that it receives armour protection and improved safety and stability.

Status

In service. As well as seeing service in South Africa, the Mamba has also been sold to Sweden.

Contractor

BAE Systems, Land Systems South Africa – OMC.

The Mamba armoured personnel carrier 0056168

The Mamba Mk3 armoured personnel carrier
(BAE Systems, Land Systems South Africa – OMC.) 0074811

Okapi 6 × 6 vehicle

Development

The Okapi has been primarily designed as a command post vehicle. However, it can also be adopted for other specialised roles, including specialised anti-mine equipment carrier.

The Okapi command post vehicle is now being offered by Denel Land Systems as part of a complete artillery system which also includes the G6 155 mm/45 calibre 6 × 6 self-propelled gun, ammunition support vehicles and fire-control system as well as long-range reconnaissance systems.

Description

The occupants of the vehicle are protected against 7.62 mm NATO ball ammunition fired from as close as 30 m. The protection level can be upgraded to meet specific needs or users' requirements. The occupants are also protected against the detonation of two TM-57 anti-tank landmines anywhere under the hull and three TM-57 landmines under any wheel station. According to the manufacturer, two Russian TM-57 anti-tank landmines can be placed anywhere under the hull or three TM-57 anti-tank landmines can be placed under any wheel without any injury to the occupants. The layout of the vehicle has been designed to obtain optimal mass distribution, while also offering good space utilisation for the crew and equipment.

The Okapi is a 6 × 6 monocoque hull vehicle with the engine positioned in the front. It has a close-coupled automatic transmission with integral torque converter/retarder unit. The high power-to-weight ratio and the utilisation of 16 × 20 tyres give the vehicle good mobility in sand or desert conditions.

Okapi 6 × 6 vehicle showing steering on the front four wheels 0021349

Specifications
Crew: 2 + 4
Configuration: 6 × 6
Combat weight: 22,000 kg
Length: 8.047 m
Width: 2.48 m
Height: 3.30 m
Ground clearance: 0.48 m
Angle of approach/departure: 40/49°
Max speed: 100 km/h
Fuel capacity: 420 litres
Fording: 1.2 m at 5 km/h
Gradient: 60%
Side slope: 45%
Vertical obstacle: 0.60 m (at crawling speed)
Engine: ADE 447 TI 6-cylinder 4-stroke turbocharged diesel developing 394 hp at 2,200 rpm
Transmission: Allison HT 740 4-speed automatic with input retarder
Suspension: semi-elliptical leaf spring packs and double-acting telescopic shock-absorbers with all axles stabilised by torsion bars
Electrical system: 24 V

Status
Production as required. A small number of vehicles are in service in electronic warfare roles with the South African National Defence Force.

Okapi 6 × 6 vehicle 0512669

Contractor
BAE Systems, Land Systems South Africa – OMC.

RG-31 armoured personnel carrier

Description
The RG-31 (known in the US as 'Charger') was designed to undertake a number of roles, including border patrol and to secure perimeters where a significant landmine threat exists. First models were completed in South Africa in 1998.

The 4 × 4 RG-31 has an all-welded armoured shell designed to resist small arms fire up to 5.56 × 45 mm. Bullet-resistant armoured glass is fitted and the unique body shape both limits damage caused by anti-tank mines and minimises the period of downtime following a landmine detonation under the vehicle. The hull is designed to withstand a double TM-57 level mine explosion under any wheel and a single detonation centrally below the vehicle.

RG-31 has a V-shaped monocoque hull to which leaf spring suspension is attached. The vehicle has a wide rear door, roof hatches and large armoured glass windows for all-round visibility. It is equipped with externally mounted stowage bins and an externally mounted fuel tank which minimises the threat of an interior fire.

Right-hand and left-hand drive configurations are available, while full air conditioning and power-assisted steering are standard features. Power from the Cummins QSD 205 kW, six-cylinder direct injection diesel engine is transmitted via a four-speed automatic gearbox and a high/low range transfer box to rigid type drive axles.

The RG-31 has a power-to-weight ratio in excess of 15 kW/tonne and full 4 × 4 drive with differential locks.

RG-31 armoured personnel carrier (BAE Systems, Land Systems South Africa – OMC) 1289276

Status
In production and in service with the US forces, Canadian forces, UN and several others.

Contractor
BAE Systems, Land Systems South Africa – OMC.

United Kingdom

Transac integrated EOD solutions

Description
Transac is believed to be one of the world's larger suppliers of consolidated Improvised Explosive Device Disposal (IEDD) vehicle packages. The company has expertise in the integration of combat-proven systems and equipment to provide effective and practical solutions.

Consolidating this equipment into a custom-built, high-speed unit is essential for an instant response. Vehicle conversions range from small equipment carriers with limited carrying capacity, to large command/control centres with integral support systems, workshops and forensic laboratories.

Of over 300 potential vehicle modifications and fittings, each may be of significant importance for bomb detection, 'render-safe' and controlled disruption. Threat analysis will often determine the necessary equipment level.

Transac utilises chassis from a range of suitable suppliers including Mercedes Benz, Land Rover, GMC and Iveco.

Once the necessary equipment level has been decided, Transac can either undertake a full conversion of an appropriate standard van chassis, or produce a tailor-made 'box body' on a chassis cowl frame. When required, vehicles can be equipped with advanced external communications and warning systems. The final fitments, colours and trim are then selected individually, designed either to blend into existing vehicle livery, or remain completely covert.

It is possible to armour most units to a moderate blast and fragmentation level. Higher levels of protection are only available on the few selected chassis capable of accepting the substantial payload increase necessary, without compromising performance.

Transac IEDD equipment (Transac International Limited) 0129051

Status
In production.

Contractor
Transac International Limited.

SERVICES

Agents for equipment
Clearance
Consultancy
Humanitarian
Information
Medical
Training

AGENTS FOR EQUIPMENT

Germany

MELTRON International Security Services GmbH

Description
MELTRON ISS GmbH provides a wide range of security equipment and systems, especially in the EOD/IED and EOR fields. Products include: EOD/IED mobiles for explosive ordnance disposal, equipped with security equipment and systems (including bomb disposal trailers and robots), remote-controlled robots and robot systems, explosives and metal detectors, recoiless de-armers and disrupters including cartridges (12.7 mm), amagnetic EOD/IED tool sets, hook and line sets, and X-ray screening equipment. Services include: security advisory service, and training in Germany and/or in customer's country. The company offers security for big international events and VIP visits. Customers include: German and European armies, German and European police and special task forces, German and European departments and enterprises, military and police authorities, and NATO suppliers.

Contractor
MELTRON International Security Services GmbH.

United Kingdom

Allen-Vanguard (formerly PW Allen & Company Limited)

Description
Allen-Vanguard (formerly PW Allen & Company Limited) has long established connections with the army, police, Immigration, and Revenue and Customs authorities in the UK. Its detailed knowledge of a wide range of internal security problems enables it to offer advice on the latest techniques to combat specific threats and to supply equipment to meet each need.

At the heart of the company is a research and development group with skills in electro-mechanics, optics, electronics, microprocessor control and software engineering.

In addition to its own manufactured products, Allen-Vanguard supplies a wide range of internal security equipment and also offers turnkey total procurement project management. Allen-Vanguard's principal equipment expertise is in the fields of EOD/Improvised Explosive Device Disposal (IEDD), high risk search, contraband search, surveillance, rapid intervention and method of entry. Training courses can also be provided covering use of the equipment as well as operational procedures (see separate entry).

Allen-Vanguard is an exporter and regularly fulfils contracts to supply equipment to countries throughout the world. It attends international security exhibitions and will participate in trials and offer demonstrations in country.

Allen-Vanguard is accredited to the ISO 9001 quality assurance standard.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

Allen-Vanguard supplies a wide range of equipment and services to meet a range of threat scenarios including improvised explosive device disposal and contraband search (Vanguard-Allen) 1154140

Some of Allen-Vanguard's wide range of equipment in use (Allen-Vanguard) 1154141

SDS Group Limited

Description
SDS was formed in 1975 and offers bomb disposal training and maintenance. SDS can advise on the most appropriate equipment for a client's needs, including offering an up-to-date assessment of the latest technologies available. It is the company's policy only to recommend equipment that has proved effective and reliable under active service conditions. SDS can provide a full warranty service on all items supplied and technical support is available 24 hours a day. Equipment supplied by SDS is employed in a large number of countries throughout the world and includes X-ray equipment; mine and metal detectors; explosive and drug detection equipment; and improvised explosive device search equipment. Training courses include equipment operation, incident and risk management, postal staff training and EOD/IEDD/search team training.

Contractor
SDS Group Limited.

United States

Martin L Kaiser Inc

Description

Martin L Kaiser Inc supplies and manufactures a wide range of electronic counter surveillance, bomb detection and bomb disposal equipment. The company has provided equipment to and serviced many non-US, federal, state and local law enforcement agencies and industrial customers.

Martin L Kaiser Inc endeavours to present a realistic approach to a wide variety of electronic security problems. It can provide electronic countermeasure equipment designed to cover the three basic categories of transmitters, hard-wire systems and telephone alterations.

Due to the retirement of Martin L Kaiser, production of EOD equipment is now limited.

Contractor

Martin L Kaiser Inc.

CLEARANCE

Australia

G-tek Australia Pty Limited

Description
G-tek is a technology company offering a turnkey explosive ordnance service combining the most appropriate proprietary or third-party technologies and state-of-the-art procedures. G-tek also has a record of successful teaming arrangements through which its prime responsibilities have been technology management, subsurface detection and mapping and associated EOD quality control.

G-tek and its antecedent, the Geophysical Research Institute, pioneered the application of digital geophysical techniques to the detection of unexploded ordnance in Australia in the early 1980s. Since then it has conducted significant development of its toolbox of magnetic and electromagnetic data acquisition systems for explosive ordnance detection applications, together with digital signal processing and interpretive software. G-tek's toolbox includes modular, single-sensor and multisensor arrays that may be operated from hand-held, vehicle towed or maritime platforms delivering the flexibility to optimise performance in all site conditions. Detection performance and efficiency, independent quality audit, and discrimination against geological and other false alarm sources have received paramount attention.

The company's experience in commercial UXO projects, the in-house development of site-specific enhancements during the life of its major projects and its performance in the Jefferson Proving Grounds technology demonstrations enable G-tek to offer to accomplish both the short-term and long-term goals of any explosive ordnance detection or remediation programme. G-tek has demonstrated the performance-enhancing characteristics of its technologies and claims these have proven cost-effective in geologically adverse environments where commercial-off-the-shelf detection systems have failed.

The company has completed over 200 EOD projects since its creation in 2002. It is an accredited member of the Australian Department of Defence Unexploded Ordnance Panel (DUXOP) and has been approved for unexploded ordnance remediation work by the United Nations Office for Project Services (UNOPS).

Contractor
G-tek Australia Pty Limited.

Germany

MgM (Menschen gegen Minen)

Description
MgM (Menschen gegen Minen, meaning People against Landmines) is a German-based charitable Non-Governmental Organisation (NGO) run by the founders from the field. It is dedicated to the clearance and eradication of landmines and other UXO and to the reopening of hazardous areas in post-conflict scenarios. MgM will clear and access areas where the peace and development process is being hindered, allowing the safe return of displaced peoples and, subsequently, the agencies and organisations acting in support of relocation programmes. Funded by UN agencies, various governments and a large number of its own members; it has also received donations of vehicles, equipment and medical supplies from the US government and others.

MgM works with a 'tool-box' in Multilayer Mine Clearance (MLC). As well as having small teams of traditional style deminers using metal detectors, full visors and body armour, MgM has also trained its own free-runner dog demining capacity. MgM has also developed, and is in the process of developing, machines to augment hand clearance and dog teams, making their work safer and more efficient. With this 'tool-box' MgM is able to deploy the combination of men, dogs and machines that is best suited to the task or scenario. Machines are designed to be easily loaded onto a C-130 Hercules aircraft for rapid deployment.

Machines used by MgM include:

- F12 Caterpillar grader with air-conditioned mine protected cab. This is used for active quality control of road clearance, following dog or hand clearance, with the windrows delineating the cleared areas. A by-product of this process is that a temporary road is formed. The process is called QaM (Quality control and mechanical Marking).
- Samil 20 Rhino with commercially available mulching unit. These ex-military mine-protected personnel carriers have been converted to carry a hydraulic Maletti mulching unit on an articulated arm. The use of either, or both, of these machines in conjunction with the hand clearance teams is designated as the Mechanically assisted Manual (MaM) demining method. Should either or both of the machines be used in conjunction with the dog teams, this is designated the Mechanically assisted Dog (MaD) demining method.
- A number of self-developed devices and systems such as Voodoo, Rotar Mk I, II and III series, MAXX RC Multi-Tool version 1 and 2 and PWS (biological explosives sensor). Research and development within MgM is run by HEC (web address: http://www.ehlersconsult.com).
- Wolf III Turbo mine-proof personnel carrier, survey vehicle and test platform for advanced mine detection equipment. One vehicle is available for surveys in hazardous environments and is also fitted with an articulated, 6 m long arm to which may be attached sensors for testing in mined areas. This machine provides a safe mobile work area for operators and sensitive equipment. A second Wolf serves as a mobile operations centre.
- MgM demining operations are supported by a variety of mine-proof and mine-protected logistics vehicles, recovery trucks and mobile workshops, fuel tanker, 4×4 ambulances and a fleet of 4×4 off-route vehicles. This gives MgM the ability to construct and repair bridges in hazardous areas, as well as rebuild culverts; obstacles that normally prevent effective clearance and reopening of infrastructure.

PRB/M35 found in Nambuangongo, Angola by MgM
(MgM/Ken O'Connell) 0056160

MgM has reopened thousands of kilometres of previously closed jungle road and large community areas in its present tasks all over Angola. This road clearance and rehabilitation, along with the construction of bridges and culverts, has enabled over a hundred thousand indigenous displaced people to be resettled in safety. In Mozambique, MgM is clearing the Limpopo railway in the Gaza Province.

MgM is a field partner of various research and development projects within the Research, Development and Engineering Center at the Night Vision and Electronic Sensors Directorate, Fort Belvoir in the US and also within the European Union.

MgM is committed to openness and transparency of all its operations, in order to benefit mine action. It does not patent its inventions and publishes all of its documentation on the internet (http://www.mgm.org). Also available is a demining and explosive ordnance disposal expert e-mail user group: network@mgm.org.

Contractor
Menschen gegen Minen.

International

Handicap International

Description
Handicap International (HI) is a non-governmental non-profit organisation founded in 1982 to provide rehabilitation assistance for handicapped people in over 50 of the world's poorest nations. HI's programmes cover a range of assistance activities for the handicapped and include the fitting of over 150,000 amputees with mechanical prosthesis. Of these, a large percentage have been the victims of a landmine or UXO related accidents. First hand experience with the devastation brought about by these weapons provides the fundamental rationale for the HI commitment to direct actions to reduce the risk of landmine accidents and eliminate landmines from the environment. HI initiates and supports interventions against landmines within five broad areas of activity:

Public advocacy
HI is one of the six founding organisations of The International Campaign to Ban Landmines (ICBL) which was awarded the Nobel Peace Prize in 1997.

HI's commitment to the ICBL continues with activities supporting early ratification of the Treaty. HI supplements Landmine Monitor information with fact sheets on victim assistance and mine action in Asia and French-speaking Africa. A further supporting document, *Landmine Victim Assistance: World Report*, is released each December. The organisation also lends support to national campaigns in French-speaking Africa.

Handicap International has been a leading agency in the call for a ban on cluster munitions since February 2005. As a result of substantial campaigning efforts, in February 2006, Belgium became the first country in the world to adopt national legislation that prohibits the production, use, transfer and stockpiling of cluster munitions. The Belgian ban helped trigger the Oslo process on cluster munitions in February 2007.

In November 2006 HI published the report *Fatal Footprint: The Global Human Impact of Cluster Munitions*. This was the first comprehensive study systematically analysing the impact of cluster munitions on the civilian population through casualty data. In May 2007 HI published *Circle of Impact: The Fatal Footprint of Cluster Munitions on People and Communities*. Circle of Impact was presented to the media in about 20 countries and has been used as baseline information on the issue by most participants in the cluster munitions ban campaign.

Research
HI has long conducted independent research in areas of interest to the mine action sector, including:

- *The Use of Dogs in Support of Humanitarian Demining Operations*, July 1998;
- *The Use of Mechanical Means for Humanitarian Demining Operations*, May 2000;
  Mine Risk Education Implementation Guide, August 2001;
- *Spontaneous Demining Initiatives – mine clearance by villagers in rural Cambodia*, January 2001;
- *Evaluation of Mine Risk Education programmes and progress in Bosnia and Herzegovina*, published jointly by HI and UNICEF, 2005.

In the area of victim assistance, HI has also conducted research into the psychological impact of mine injuries on individual survivors and their families, and produces numerous technical guides for various aspects of prosthesis fabrication and physical rehabilitation.

Landmine Impact and General Survey
In 1997, HI conducted a UXO social-economic impact survey covering 15 of the 18 provinces in Laos, which was used as an early reference for the development of impact survey procedures and standards. HI completed a national landmine impact survey for Chad in June 2001, and another for Bosnia and Herzegovina in 2004. A general impact survey of the Casamance region of Senegal that was completed in 2006. Also in 2007, HI completed a survey of victims of explosive devices in Nepal.

Mine Risk Education programmes (MRE)
Since its beginnings in MRE in Mozambique in 1992, HI has played a role in the development and implementation of this type of activity. In 2007, HI MRE projects were in place in Afghanistan, Angola, Bosnia-Herzegovina, Cambodia, Democratic Republic of Congo, Kenya (for Sudanese refugees), Senegal (Casamance), Somaliland and Thailand. HI also provides technical advice for the development and implementation of MRE projects to partner agencies in Bosnia-Herzegovina, Guinea Bissau and Mozambique.

Mine Clearance operations
HI assists affected communities to develop capacities in mine clearance operations and to strengthen their management and support organisations.

Using a combination of manual, EDD and mechanical means, HI initiates and develops landmine and UXO clearance operations in a number of countries. Past operations include BAC in Macedonia and Kosovo, UXO clearance in Beghdad, Iraq and in Herat, Afghanistan. Current operations include demining in Mozambique and Bosnia-Herzegovina, BAC in southern Lebanon, demining in the Casamance region of Senegal, UXO clearance in Laos and Democratic Republic of Congo.

Contractor
Handicap International – France.
Handicap International – Belgium.

Israel

Maavarim Civil Engineering Limited

Description
Maavarim Civil Engineering Limited was established in 1995 and provides operational, consultancy, equipment supply and quality assurance services (ISO 9002 qualified) based on their experience in both military and civilian theatres. Maavarim's management team consists of officers and non-commissioned officers from the IDF (Israel Defence Force) engineering corps. All staff have military and civilian experience. MCE concentrates on three areas: Humanitarian Mine Clearance; Explosive Ordnance Disposal and Detection Dogs.

Humanitarian Mine Clearance
Maavarim conducts demining projects for commercial and non-profit organisations around the world. Where possible, equipment from Israeli manufacturers who work for the IDF (Israel Defence Forces) is used. If Israeli equipment is not locally available, Maavarim uses international manufacturers who meet the same high standard. As an integral part of any clearance operation, customers are provided with full insurance coverage, covering them in the event of the future explosion of a mine present in a cleared area. With this coverage, Maavarim's clients are confident that they shall not be held liable for damages during or after clearance operations.

Maavarim's work method varies in accordance with the nature of the terrain and the type of minefield. The work method is determined by the following parameters: AP or AT mines, type of mines, slopes, vegetation and rocks. Prior to each project, the level of risk is estimated and the work method most suitable for the area is determined.

Maavarim conducts Mine Risk Education teaching programs to the local population in order to reduce the risk of people living in proximity to minefields.

Explosive Ordnance Disposal
Maavarim's EOD division works in accordance with safety rules and regulations that comply with the IDF's regulations and other international standards.

EOD projects include the disposal of 800 tons of expired ammunition on behalf of the Israeli Ministry of Defence. The ammunition included tank shells, artillery shells, hand grenades and anti-personnel and anti-tank mines.

Maavarim is now a leading Israeli firm for demining, EOD, and Detection Dog services; it conducts projects in Israel, Balkans, Africa, central Asia, the Middle East and other areas in the world.

As well as working on Explosive Ordnance Disposal, Maavarim also has worked on expired ordnance disposal and dealing with ammunition in civilian surroundings.

Detection Dogs
Maavarim trains and operates Detection Dogs in a wide range of areas: open fields, residential/industrial areas, searching personal luggage and vehicles of all kinds. Although most of the dogs are instructed to detect explosives, (due to the high demand in the world and particularly in Israel) Maavarim trains dogs for other purposes as well according to the customer's request. Other uses may include drug detection dogs, search and rescue dogs, investigative dogs and security dogs.

Contractor
Maavarim Civil Engineering Limited.

Italy

ABC mines and UXO clearance contractor

Description
ABC are an organisation engaged in operational mine clearance. Their clearance systems generally use mechanically assisted manual demining and can also incorporate the use of mine detection dogs. ABC also project develop and patent mine clearance machines, such as the 'Scout', although they don't actually sell them.

Contractor
Appalti Bonifiche Costruzioni.

ABC's 'Scout' mine clearing vehicle (ABC) 0568872

Intersos Mine Action Unit

Description
Intersos is a humanitarian non-profit-making organisation established in 1992 to provide emergency aid to countries in a critical situation. Projects have been implemanted in countries including Afghanistan, Albania, Angola, Bosnia-Herzegovina, Burundi, Chechnya, Democratic Republic of Congo, Eritrea, Honduras, India, Mozambique, Nicaragua, Pakistan, Rwanda, Serbia (including Kosovo), Montenegro , Somalia, Sudan and the Former Yugoslav Republic of Macedonia, in collaboration with specialised UN Agencies, the European Union, the Italian government, USAID and other public and private donors.

Intersos became involved in demining activities as a result of their work in post-conflict areas where projects were being hampered by mine contamination. The Mine Action Unit (MAU) operates in all areas of mine action, including mine risk education, mine clearance, victim assistance and advocacy. The MAU regularly attends the UNMAS Steering Committee, Programme Directors and Advisors meetings as well as the Standing Committees and Member States Meetings of the Ottawa Process.

Countries of operation have been: Angola, Burundi, Chad, Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Liberia, Mozambique, Rwanda, Somalia, Sudan, El Salvador, Honduras, Nicaragua, Afghanistan, Pakistan, Iran, Iraq, India, Sri Lanka, Albania, Bosnia-Herzegovina, Chechnya, Macedonia, Kosovo, Poland, Serbia and Montenegro.

Mine awareness
Mine risk education forms a key part of all Intersos projects as a preventative measure to decrease the number of mine casualties. A wide range of activities is undertaken at field level in accordance with UNICEF guidelines. These activities include information sessions in schools, refugee camps and community centres; television and radio broadcasting; and leaflet and poster distribution. In Bosnia, Intersos made use of T-shirts, printed with drawings of mines and ordnance and showing a warning message in the local language, as a mine-awareness tool. These were distributed to schools in Sarajevo. In Pakistan a project in support of Afghan refugees living in camps along the border started in January 2002 with funding from UNHCR. The project aim is to educate people about the mine and UXO risk before their repatriation to Afghanistan. A team of six local operators have been trained, with different programmes for men, women and children.

The MAU also regularly holds its own training courses for international and local personnel in Italy and in the countries of operation.

Mine clearance
The MAU is accredited by the Mine Action Centre in the country of operation and operates according to the internationally agreed standard.

In Angola, the MAU is operative in the southern regions of Huila and Cuando Cubango. From 1999 to 2001 a mine action project, funded by the European Commission and the Italian government, was implemented in support of IDP return and resettlement in the Huila Province. A large number of tasks, including EOD, Battle Area Clearance (BAC) operations, UXO demolitions and Level 1 and Level 2 surveys have been implemented.

Then, in 2003, the MAU undertook a project to improve the humanitarian situation and support the peace process by supporting the demobilisation, reintegration and return process of displaced persons and refugees in the Huila Province.

Victim assistance
Intersos is implementing a project supporting a centre for prosthetics and the rehabilitation of mine victims in Cuando Cubango Province, Angola. The project includes training of local people in prosthetic production and rehabilitation skills. Special attention is given to the social and economic reintegration of disabled people through vocational training.

Support is also given to the surgical department of the Provincial Hospital at Menongue.

Advocacy
Intersos is a member of the Italian Campaign to Ban Landmines and supported the approval of Italian laws against the use and proliferation of landmines as well as ratification of the Ottawa Treaty by the Italian government. The MAU has participated in research for the Landmine Monitor.

Contractor
Intersos.

United Kingdom

BACTEC International Limited

Description
BACTEC (Battle Area Clearance, Training, Equipment and Consultancy) is a specialist explosive ordnance disposal and mine clearance company. Established in 1991, BACTEC was set up to provide risk mitigation services for unexploded ordnance (UXO) and mine clearance, construction projects and worldwide explosive ordnance clearance initiatives. In April 2008, BACTEC International Limited was honoured by Her Majesty the Queen and awarded the 'Queen's award for EOD and Mine Action Specialist' for the company's outstanding export performance. BACTEC has been directly involved with the disposal of more than 500,000 land mines and thousands of tonnes of unexploded ordnance, clearing or verifying over eight million square metres of contaminated land across 40 countries.

Recent projects have included:

- Azerbaijan – a level 1 impact survey for the UN;
- Cambodia – provision of third party quality assurance;
- Hong Kong – survey and clearance for a major Hong Kong development;
- Indonesia – survey and clearance of a former airfield, including the detection and disposal of over 2,500 items of ordnance;
- Kosovo – provision of emergency response EOD support, training of local personnel and battle area clearance;
- Lebanon – clearance of an area of over 1.5 million square metres, involving in excess of 40,000 mines and items of ordnance from 2001-2004 and BAC and EOD rapid response, mine and cluster bomb clearance from 2006-2007;
- Libya – Level 1 survey
- Taiwan – clearance of over 1 million square metres of maintained areas;
- Yemen – marine survey and diver investigation of Aden Harbour and battle area clearance of surrounding land; and
- Zimbabwe – covering over 2 million square metres, provision of third-party quality assurance for the European Commission's main mine clearance contractor.

BACTEC deminer breaching into minefield (BACTEC) 1190607

Where possible, BACTEC recruit and train local personnel to undertake mine clearance and liaise with the local community. It also provides mines risk education (MRE). During clearance projects it can deploy manual clearance teams, mine detection dog teams and mechanical systems and offer project management support. Its operations are carried out in accordance with International Mine Action Standards (IMAS) and Information Management System for Mine Action (IMSMA), as well as country-specific technical and safety guidelines, and its own standard operational procedures.

Status
Clients include overseas governments, UN, EC, international oil, gas and construction companies, with major contracts having been won recently in Australia, Lao PDR, Lebanon, Libya, Cambodia, Mozambique and Belgium.

Contractor
BACTEC International Limited.

For details of the latest updates to *Jane's Explosive Ordnance Disposal* online and to discover the additional information available exclusively to online subscribers please visit **jeod.janes.com**

CLEARWAY Explosive Services Limited

Description

CLEARWAY Explosive Services Limited is an independent British company which specialises in the use of explosives in land and underwater operations. Besides using explosives for engineering projects, CLEARWAY is also actively involved in the detection, mapping, clearance and removal of mines and unexploded ordnance from minefields, war zones, firing ranges, ships and navigation channels.

CLEARWAY's main area of operation has been the Middle East. Between 1987 and 1989, the company was involved in the inspection, location and removal of unexploded weapons from 26 ships and offshore installations. In 1990, the company located, removed and disposed of 18 Second World War mines from a North Sea pipeline, using an underwater remotely operated vehicle and a throughwater acoustic firing device. During 1990 and 1991, CLEARWAY had over 160 personnel working in Kuwait supervising and carrying out large-scale minefield and battle area clearance operations using a combination of mechanical and manual methods. During this period the company was also contracted to dispose of 80 tonnes of decomposed nitroglycerine-based explosive in Indonesia. In October 1992, the company disposed of a 100 kg cratering bomb to allow a West African port to reopen to shipping. In 1996 to 1997, the company carried out the detection and removal of an ammunition dump in and around Beirut harbour.

CLEARWAY is regularly engaged in the type of work mentioned above and, with the backing of the UK Ministry of Defence, has worked in close liaison with international organisations and overseas ministries of defence. Its personnel are full members of the British Institute of Explosives Engineers.

The company has produced a computer-aided mines and munitions identification system, which includes illustrations and disposal techniques to ensure safe removal. Items likely to be found in a given area can be quickly printed out to produce a detailed reference manual.

Based on its experience, CLEARWAY offers advice, practical help and training on all aspects of minefield survey and the clearance of mines and unexploded ordnance; the company will also recommend the number of personnel and the most cost-effective equipment for each task. CLEARWAY is also licensed for the disposal of pyrotechnics and explosives either by incineration or detonation, and has a site with an abrasive, high-pressure water jet cutting system suitable for cutting into and the disposal of explosive items.

Contractor

CLEARWAY Explosive Services Limited.

European Land Solutions

Description

The Safinor Group includes European Land Solutions Ltd (ELS) based in the UK, ELS Deutschland GmbH based in Berlin and Essen in Germany and S^{2}AG, based near Zurich in Switzerland. All members of the group bring a common approach to their operations and between them, the group members carry out projects in munitions and landmine clearance around the world. These include the United Nations demining project in Northern Iraq and the major area clearance project in eastern Russia in support of the oil industry.

The group deploys its own people, dogs and machines for direct area clearance operations, survey and quality assurance functions. Whenever appropriate, partnerships with local agencies or specialist organizations are included in the service provision package.

ELS is fully accredited under ISO 9000:2000 and is committed to becoming an Investor in People. Other group members use the same ISO 9000 quality system and a standardised system of Health and Safety, Environmental Management and administrative support procedures ensures commonality and efficiency across all projects.

ELS activities and operating procedures meet International Mine Action Standards (IMAS) fully and the Group CEO is an industry representative on the IMAS review board. The organisation's approach is one of continuous improvement and its mission is to provide the world's finest quality and value for money in munitions clearance work. The organization is a constant supporter of the Institute of Munition Clearance Engineers and has provided personnel to work with the UK Government on the development of formal Occupational Standards for the Industry. Senior staff members work closely with Cranfield University on the development of management systems for the industry and lecture at management courses on a visiting basis.

The organization draws upon accumulated experience of some of the world's largest mine action contracts and other munitions clearance operations in some of the world's most challenging environments. Its staff are drawn from more than 15 different countries.

Services

All group member companies provide munition clearance services encompassing the whole range of activity from advice and investigation through survey and clearance to quality assurance of landmine, unexploded ordnance and other forms of military contamination. Additionally, through S^{2}AG, manpower hire, logistics, field camps, field catering, sanitation and vehicle fleet management services are provided within group projects and as stand-alone services to clients. Risk management, training and a range of civil engineering functions may be provided from within the group.

The group employs the traditional ELS approach of ensuring complete integration of design, planning, procedures, training, operations, field management and evaluation. The starting point for all operations is a clear understanding of the client's objectives. The group's approach is designed to cope successfully with every eventuality, taking in its stride differences in terrain, climate and threat and with a clear understanding of the importance of adhering to local legislative systems.

'Bulldog' operational in the Balkans (ELS) 0529571

An ELS deminer at work (ELS) 0529572

Current and Recent Deployments

Iraq (ELS). ELS has been involved with extensive clearance work in Iraq and continues to do so, working in support of major rebuilding of the country in the wake of post-war conflict.

Sakhalin (ELS). ELS is working in support of a major oil and gas development project in an area offering a harsh environment and against tight deadlines with major implications for one of the world's largest investment exercises. Within the project, ELS provides a service meeting the exceptionally demanding Health and Safety and Environmental standards of the oil and gas industry as well as a comprehensive quality assurance system.

Germany (ELS Deutschland). ELS Deutschland works for local authorities in Germany clearing Second World War munitions. The company is the first one to apply formal ISO 9000 quality assurance systems to the task within Germany.

Bosnia (ELS Bosnia). The group has a major mechanical systems project in Bosnia providing machinery services to other operating organizations in the country. The project works under a tight financial regime that ensures that the skills and resources necessary to maximize machinery operating-time in the face of routine and emergency maintenance are managed to best effect.

Vietnam (ELS). ELS have been working alongside an American charity to help the Vietnamese government develop their own structures and systems for dealing with the residual munition problem facing the country. Concentration upon the use of existing organisations and resources within the country through a step-by-step approach has produced excellent results with local government confidence at every stage.

Mozambique (ELS Deutschland). Building upon the exceptional experience gained in machinery operations in Bosnia, ELS Deutschland is now offering mechanical support services within Mozambique using Khron machines.

Kosovo (ELS). ELS provided cluster bomb clearance services under contract to the UK government. In addition to providing a service that was unique in never failing an external quality inspection, the project was the first occasion on which the use of dynamic modelling systems to help predict output through the climatic cycle proved valuable. Such systems are now routinely used in all group operations.

Angola (ELS). ELS worked in Angola for several years with CARE International on projects which established many principles now commonly used in the industry, in terms of linking mine action to follow on humanitarian activity.

Contractor

European Land Solutions Limited.

Fellows International Limited

Description

Fellows International Limited is an independent specialist diving, explosives and munitions clearance company. From origins within Royal Navy and Royal Engineers clearance diving, bomb and mine disposal disciplines, the company has developed into a specialist contractor providing a total, all embracing, rapid response clearance diving and munitions location and disposal service, on land and underwater, to national, Non-Government Organisations (NGOs) and civil authorities worldwide.

The company's development is based on the founder's unique hands-on bomb and mine disposal career which commenced with the Suez Canal Zone clearance in 1966 and has continued since then without a break. The company employs only accredited ex-military EOD personnel trained at recognised EOD schools and has a significant investment in the technologies involved in state-of-the-art mine location and associated equipment.

With the ever increasing commitment to safety and quality demanded by clients, all company operations adhere to written quality and safety policies. These policies are based on operational experience which includes managing a 3-year mine and munition clearance project in Somalia. Other major operations have included the clearance of six major Second World War Japanese and American minefields on South Pacific islands, lease-lend employment with the US forces in Vietnam, operational bomb and mine clearance during the Falkland Islands conflict and the removal of damaged missiles from a British warship in the Persian Gulf. Specific services and applications available include the following:

- threat assessment and risk analysis;
- munitions safety audits on land and underwater;
- minefield clearance above and below the high water mark;
- geophysical and munitions location surveys;
- military range and battle area clearance;
- munitions awareness and first aid trauma treatment and training;
- side scan sonar and sub-bottom profiler surveys of harbours and waterways;
- munitions clearance project management;
- underwater EOD clearance for sunken vessel salvage.

The company remains at the forefront of current technology by membership of the Institute of Explosives Engineers, the Committée de Minex, the European Demining Services Consortium, World EOD Foundation and the Society of Underwater Technology. Fellows International Limited is the first British company to have been assessed and approved to ISO 9001 in diving explosives and munitions clearance (GB 2021).

Contractor

Fellows International Limited.

MACC International Ltd

Description

MACC International Ltd specialises in the clearance of Explosive Ordnance (EO) and mines in the UK and throughout the World on land or under water. MACC is UN registered and an ISO 14001:2004 accredited company with experience of EOD operations worldwide in support of international governments, local authorities, aid agencies, the seismic survey industry, construction and major oil companies. MACC has an overseas office in Kuala Lumpur, Malaysia.

Recent projects include:

- Clearance of EO from an 18,000 hectare site in Asia
- Geophysical survey and EO clearance of a former Royal Air Force (RAF) station
- Investigation of suspect chemical weapons in Oxfordshire
- Investigation of suspect chemical agents at a former RAF station
- Down the hole geophysics survey for UXB in Sussex
- Geophysical survey and bomb clearance on the route of the Channel Tunnel rail link
- Underwater investigation for UXO in a redundant dock in Liverpool
- Search and clearance of trail pits at a UK Atomic Energy Authority site
- Confidential desk studies of potentially UXO contaminated areas of the UK
- Mine clearance in Asia
- Geophysical survey of a site in London for a major development company.

500 kg German bomb recovered from a site in Oxfordshire, UK (MACC International) 0123512

Contractor

MACC International Limited.

Mines Advisory Group

Description

The Mines Advisory Group (MAG) is one of the world's leading humanitarian organisations providing conflict-affected countries with a chance for a better future by providing expert solutions to landmine and explosive ordnance contamination. MAG offer the following services:

- Risk assessment
- Contamination mapping
- General, technical and emergency survey
- Project Management
- Emergency EOD response
- Clearance and high risk search
- Quality management for third-party clearance
- Mine risk education (MRE) and community liaison
- Small arms and light weapons stockpile management

MAG's long term approach enables countries to rebuild their own social and economic potential with focus on areas where the humanitarian impact is greatest. By employing and training national staff from amongst effected communities, MAG seek to improve local economies. The development of key infrastructure is aided by opening up safe access routes between villages and communities, allowing safe access to water, food and shelter for communities as well as increasing trade potential. The clearance of land is intended to provide safe land for wide-scale agricultural developments and construction projects such as schools, health centres and housing. MAG also assist in maintaining peace by destroying illicit stockpiles of weapons and munitions.

MAG is a co-laureate of the 1997 Nobel Peace Prize.

History

MAG has its roots among aid workers who witnessed the problems that landmines were causing for rural populations in Afghanistan. MAG's founder established a mine-eradication element in a multi-disciplinary rehabilitation programme in Paktia province, Afghanistan in 1988 and, in 1990, took the first UN-funded Afghan mine clearance teams into Kunar Province. In mid-1990 the Mines Advisory Group was formed in Peshawar, Pakistan, funded by the Norwegian and Swedish Committees for Afghanistan. In 1991 the organisation moved its base to the UK, became an international NGO and, in conjunction with Human Rights Watch and African Rights, published a series of reports on the mines situation in Angola, Cambodia, Laos, Northern Iraq and Northern Somalia.

MAG currently has programmes in Angola, Cambodia, the Democratic Republic of the Congo (DRC), Laos, Iraq, Sri Lanka, Lebanon, Sudan and Vietnam. Additionally it is running training and assesment projects in Nepal, Repubic of Congo, Burundi and Somalia.

Clearance and training programmes

MAG trains local teams to survey, mark and clear minefields and destroy unexploded ordnance and stockpiles of small arms and light weapons. To ensure sustainability, local staff are trained to match the skills of the expatriate trainers. A high level of technical expertise, coupled with protective clothing and equipment, ensure that all MAG staff work as safely as possible.

The organisation focuses its clearance resources in areas where the work will benefit the maximum number of people in the greatest need. To do this, MAG works in co-operation with local people to develop a qualitative understanding of how they are affected by landmines and unexploded ordnance and how their needs can best be met. The land that is cleared first should be the land most important to the community, not the land where the most dangerous items are found.

Priority areas are generally agricultural land, land for resettlement or reconstruction and access paths to water, schools or other important community resources or facilities. MAG teams carry out a 100 per cent search for mines and ordnance in land that is to be returned to the community. In doing so, they have built up relationships of great trust with the local population.

Community Liaison
Community Liaison (CL) is the medium through which MAG gathers, analyses and disseminates information in order to identify and implement the most effective solutions to the obstacles and dangers caused by the remnants of conflict. This enables resources to be focused on the areas of greatest need.

CL is not a prescriptive process, but there are key components, which include:

- **Liaison with key stakeholders:** The exchange of up to date and relevant information between all affected parties such as communities, development agencies and local authorities throughout the whole clearance/Mine Risk Education (MRE) process. This reduces delays in operations by reducing bureaucracy, confusion and misunderstanding. Liaison also reduces friction between community members and clearance teams and provides confidence that cleared areas are safe
- **Strengthening of local information networks and agencies:** The development and strengthening of sustainable reporting structures, coordination networks and capacity building of local partners to better manage the threat of UXO
- **Data gathering and information management:** The gathering, compilation and analysis of relevant and timely data that includes baseline survey, data for prioritisation and implementation of tasks through to measurement of outcomes and impact of MAG's work and production of case studies.

CL teams are recruited from the area of operations and therefore reflect the ethnicity of the region and can communicate in local languages. Teams consist of both men and women, are highly mobile and trained in data collection and analysis, liaison techniques and MRE delivery.

Mine Risk Education
Mine Risk Education (MRE) helps people to safely live, work and travel through areas contaminated with landmines or other UXO. MAG adopts an approach that is intended to ensure that the target audience has the knowledge and the skills required to adopt feasible strategies and take appropriate action, which will keep themselves or others safe.

The design and implementation of MRE activities is dependant on factors such as the target audience, the context in which they live and the underlying reasons for risk taking behaviour. Content is tailored towards these needs but may include:

- Recognition of commonly found remnants of conflict
- Known areas of contamination and accidents in the locality
- Areas likely to be mined, warning clues and signs
- How to find out about safe and dangerous areas
- How to carry out daily activities safely
- How to keep others safe e.g. returnees, younger siblings
- How to report a dangerous item
- What to do in an emergency situation
- Alternative strategies that could be implemented by the community and/or outside agencies to minimise risk.

MRE can be delivered in a variety of ways such as through radio and TV broadcasts, participatory face to face discussions, billboards, posters and drama. MAG also instructs trainers such as teachers and religious leaders in the delivery of MRE. Materials which support the delivery of MRE such as school curricula, safe village packs and a range of small media are designed and distributed by MAG.

Two Armtracks fitted with rollers being used to verify that the land is clear of mines (Sean Sutton/MAG) 1330097

Fadel Assi, a MAG team leader, places an explosive charge next to an M42 submunition in Southern Lebanon (Sean Sutton/MAG) 1330096

Emergency Response
The 2006 emergency in Lebonon highlighted MAG's ability to mobilise quickly to crisis situations and provide and effective response. Immediately following the ceasefire roads, homes, villages and orchards were littered with unexploded munitions. MAG was the only international NGO providing clearance operations, directly assisting UN agencies, other NGOs and other international organisations distributing humanitarian aid and begining the reconstruction effort.

Contractor
The Mines Advisory Group.

MineTech International

Description
MineTech International is a specialist in the management of integrated mine clearance and Explosive Ordnance Disposal solutions on a worldwide basis.

MineTech utilises manual, canine and mechanical methods for demining and security services. The company owns and operates all of its resources and places a heavy emphasis on reviewing and improving services through Research and Development.

Contractor
MineTech International.

Specialist Gurkha Services

Description
Specialist Gurkha Services UK Ltd (SGS) is a UK-based company with representative offices in Australia, Bosnia, Croatia, Hong Kong, and Taiwan. SGS specialises in the management of projects in high-risk environments with particular emphasis on reconstruction and development projects and those seeking to return land to productive use. SGS has experience which includes direct munitions clearance operations along with humanitarian assistance projects, security operations, expedient engineering services, capacity building and support projects, training and supervision projects and change management and quality management projects. In recent years SGS has planned, implemented and managed projects in Angola, Cambodia, China, Iraq, Laos, Mozambique and Sudan. Clients include the United Nations, European Union, national governments, non-governmental organisations and commercial firms.

The company's systems are accredited to ISO 9002.

Contractor
Specialist Gurkha Services UK Ltd.

A Specialist Gurkha Services operator 0512871

The HALO Trust

Description

The HALO Trust is a non-political, non-religious British charity and American non-profit organisation (501c) that specialises in the removal of the debris of war. HALO, the Hazardous Areas Life-support Organisation, was formed in 1988. It currently has clearance operations in Abkhazia (Georgia), Afghanistan, Angola, Cambodia, Kosovo, Mozambique, Nagorno Karabakh, Somalia and Sri Lanka. HALO has 7,000 mineclearers (and 30 expatriate) in 9 countries, with on-going surveys into new regions. On 19th June 2002, HALO celebrated clearing its first million landmines and other unexploded ordnance (UXO). By late 2007 the total figure had almost reached 10,000,000 items.

HALO uses a One-Man-One-Lane (OMOL) system for the majority of its manual clearance work, as it sees this as the key to maximising productivity. Committed to developing the use of standard agricultural equipment and construction machinery in the mine clearance process, HALO now deploys 113 mechanical clearance units, including medium wheeled loaders, stone crushers and mechanical vegetation cutters fitted to standard agricultural tractors, bulldozers and a heavy crawler crane. HALO deploys this array of machinery in support roles (vegetation cutting and the cutting of breach lanes) for manual demining, and in independent clearance work, particularly in areas where heavy metal contamination adversely affects manual clearance. HALO also deploys mine detecting dogs.

Wherever HALO works it engages in mines awareness training as a complementary activity to mine clearance. Survey and information dissemination are also key elements of HALO's activities, with completed full surveys in Cambodia, Eritrea, Kosovo, Mozambique and Sri Lanka. In Abkhazia and Nagorno Karabakh HALO directly supports the Mine Action Centres in lieu of the UN.

HALO's aim is to "get mines out of the ground, now", as a non-political organisation HALO does not engage in lobbying activities. The HALO Trust undertakes no commercial work and is funded by governments, international institutions and private foundations.

Contractor

The HALO Trust.

Unexploded ordnance location and identification service

Description

BAE SYSTEMS Environmental Services, in partnership with Pelorus Surveys, offers a complete geophysical screening service for the detection and identification of buried unexploded ordnance (UXO), explosive materials, Chemical Weapons Agent (CWA) or radioactive substances. A combination of surface and borehole geophysical techniques, together with more conventional shallow UXO detectors, enables the location of targets from the surface to depths in excess of 10 m where required, for example before piling work. State-of-the-art systems are used to provide high sensitivity data acquisition, thus allowing extensive post-processing of the data where required and also allowing for third-party quality control.

Geophysical screening for UXO (BAE SYSTEMS)
0079797

Contractor

BAE SYSTEMS Environmental Services.

United States

RONCO Consulting Corporation

Description

RONCO Consulting Corporation, an international professional services firm based in Washington, DC, specialises in humanitarian mine action and ordnance disposal, environmental remediation, security services and post-conflict operations. Since 1989, RONCO has played an integral role in the creation and development of indigenous humanitarian demining, mine and unexploded ordnance (UXO) clearance, and explosive and improvised explosive ordnance disposal programmes in over 35 countries.

RONCO is currently operational in Afghanistan, Iraq, Mozambique and Sudan; its portfolio of clients includes the US Department of State (DoS), US Department of Defense (DoD), US Agency for International Development (USAID), the United Nations (UN), NATO and the NATO Maintenance and Supply Agency, the Canadian, British, German and Japanese governments, and engineering and construction firms such as Fluor, Louis Berger Group, Perini, Rizzani deEccher and PAE.

Expertise

Historically, RONCO has sought out every opportunity to train, mentor and integrate host country nationals into its programmes, complementing the broader technical knowledge and experience of its supervisory expatriate staff. RONCO trains and employs locals in:

- Manual demining;
- Mine detection dogs (MDDs);
- handling of Explosive detection dogs;
- Explosive ordnance disposal (EOD);
- Improvised explosive ordnance disposal;
- Counter improvised explosive devices (IED);
- Basic/advanced trauma life support;
- Security;
- Management.

RONCO-advised EOD teams prepare to destroy rockets found in Afghanistan (RONCO)
1041126

MDD team, trained and operated by RONCO, survey for mines in the Nuba Mountains (RONCO)
1041127

RONCO's operations are based on the host country's needs and requirements, and are tailored to support national development strategies, while simultaneously emphasising the development of an indigenous staff and organisation capable of planning, implementing and managing every aspect of mine action. RONCO employs nearly 125 technical advisors highly skilled in training and implementation of mine and UXO disposal, improvised explosive device disposal (IEDO), counter-improvised explosive device (C-IED) and security programmes. Worldwide, RONCO employs over 1,300 staff including sizeable national capacities in Afghanistan, Iraq, and Sudan.In hostile environments like Afghanistan and Iraq, RONCO also has experience providing its own security element to each of its tasks.

Current Operations

Afghanistan

Since early 2002, RONCO has provided demining and UXO clearance in support of Coalition forces at Bagram and Kandahar air bases. Currently, RONCO employs over 330 personnel, 30 MDD teams, and operates four Casspir mine clearance vehicles at Bagram. During 2007 these teams cleared and proofed over 2.8 million square meters of land, finding and destroying 223 mines and 34,210 items of UXO.

For the past four years, RONCO has undertaken over 400 commercial UXO/demining survey and clearance tasks supporting construction and development in Afghanistan.RONCO's work has supported the larger initiatives of the US DoS, USAID, US Army Corps of Engineers (USACE), NATO Maintenance and Supply Agency, and the UN. These tasks, conducted countrywide, have resulted in the clearance of over 55 million square meters of land since 2004.

RONCO is also implementing a training program for the Combined Security Transition Command – Afghanistan designed to institute a viable IEDD and EOD operator and training cadre capacity within the Afghan National Army (ANA) and Afghan National Police (ANP).Both the ANA and ANP are developing a capability to field EOD units in support of ongoing operations and to reduce the burden on coalition forces.

As mentioned previously, RONCO employs a 300-person security force in Afghanistan to support its own mine clearance and training operations and also as a service to governmental, non-governmental, and commercial clients.This structure includes: personal security details, minefield escorts, explosive detection dogs, and static security assets.

Iraq

In 2008 RONCO focused its efforts on the continued development of the Iraqi Mine and UXO Clearance Organization (IMCO), the first national demining non-government organisation (NGO) established in Iraq. A major achievement during this period was the successful implementation of a funding mechanism allowing IMCO to receive funding from the DoS and other international donors. Despite ongoing security challenges, IMCO/RONCO have cleared over 14 million square meters of land and destroyed over 120,000 UXO since 2003. RONCO is currently working to establish a SA/LW destruction and mechanical demining capacities within IMCO.

In addition to developing and advising IMCO, RONCO also continues to provide personal protective security and support for all employees and War Relocation Authority (WRA) facilities in the International 'Green' zone in Baghdad, Iraq and during deployments. Security services include static security, personal security details, minefield escorts, explosive detection dogs, and a quick reaction force capability.RONCO also provides canine detection support on the Baghdad Embassy Security Force contract and contracts in Erbil and Camp Phoenix, providing over 85 EDD/handler teams, as well as dog trainers and supervisory personnel to safeguard US embassy and other DOS personnel and facilities. These teams work seven days a week to secure properties and control access within the International zone, searching for weapons, explosives and IEDs and deterring terrorist and insurgent activities in their areas of concern. On average, RONCO EDD teams search over 80,000 vehicles per month.

RONCO (RONCO)
1041129

Sudan

Starting in July 2007, RONCO engaged in an ongoing UN contract by deploying international supervisors to lead 10 local national manual clearance teams and two mechanical clearance teams. Supporting the North Regional Mine Action Office in Kadugli, six manual clearance teams and one mechanical asset demined a variety of mountainous defensive positions in the Nuba Mountain region of South Kordofan.Additionally, four manual teams and one mechanical team demined a large minefield outside the town of Kurmuk near the Sudan-Ethiopian border.Throughout 2007 and into early 2008, RONCO continued work with the Word Food Programme (WFP) Roads and Dykes Rehabilitation Project based in Juba. Survey teams, manual deminers, mine detection dog teams, and both heavy and light flails aided in the clearance of key roads stemming from the regional hub of Juba.In October 2007, RONCO deployed a senior technical advisor and an international clearance team to South Sudan for the clearance of a new embassy compound in Juba on behalf of the US DoS. From November 2007 to February 2008, RONCO teams cleared eight critical bridge locations from Juba to the Ugandan border in support of USAID initiatives on behalf of the Louis Berger Group.

Contractor

RONCO Consulting Corporation.

USA Environmental Inc

Description

USA Environmental Inc (USA) is a small business focused solely on providing munitions response services, including characterisation and remediation of federal and non-government sites that are contaminated with munitions and explosives of concern (MEC) and unexploded ordnance (UXO).

USA's key munitions response services business areas are as follows:

- MEC avoidance for engineering, environmental, construction, forestry and archaeological firms performing a variety of field operations, including geophysical data collection, surveying, well drilling and monitoring, tree planting and archaeological studies;
- Determination and characterisation of MEC contamination, and the provision of alternative methods of clean up, including a preferred method; the company also provides intrusive MEC services including detection, excavation, inspection, identification and removal/disposal;
- Consultation in the form of professional advice, technical expertise and safety oversight for work areas that may involve MEC;
- Provision of MEC services to maintain active military firing and bombing ranges, including the periodic removal of MEC and munitions debris near the impact zone and the maintenance and replacement of targets; and
- MEC-related services such as: Digital Geophysical Mapping (DGM); GPS surveying and GIS mapping; MEC underwater capabilities; range reconnaissance; comprehensive site evaluation (CSE); remedial investigation/feasibility studies; engineering evaluation/cost analysis; technology evaluation; demining; cost, schedule and risk controls; and archival searches and cultural compliance.

USA Environmental has successfully completed over USD300 million worth of MEC work and contracted for over 350 projects/task orders. It has performed NEC work in most US states and abroad in locations such as Canada, Iraq, Japan, Puerto Rico and the Virgin Islands. It performs munitions response work both as a prime contractor and as a subcontractor. The majority of projects are undertaken for the US government, including the US Navy, US Air Force and US Army, especially the US Army Corps of Engineers. The company employs over 140 people and all its UXO personnel are graduates of the US Navy Explosive Ordnance School.

USA Environmental
(USA Environmental)
1154601

Contractor

USA Environmental Inc.

CONSULTANCY

Canada

Fugro UXO detection system

Description
The Fugro UXO detection system comprises high-speed, low-noise, helicopter-mounted magnetometer technology using an array of Cesium magnetometers housed inside rigid booms and mounted externally on a helicopter. The resulting system is suitable for UXO detection and extremely low-altitude flying, as low as 1 m where topography and vegetation allow.

The system can be used to:

- Define areas with potentially large quantities of UXO
- Detect and locate specific ferrous targets such as UXO, pipelines and other buried metallic objects

The system has been used for several surveys including:

- Bellows Air Force Station, Hawaii, 1999
- Brustem Airbase, Belgium, 1999
- Badlands Bombing Range, South Dakota, 1999
- Pinecastle Impact Complex, Florida 2000
- Massachusetts Military Reservation, Massachusetts 2000
- Redstone Arsenal, Alabama 2001

General specifications of the UXO detection system

- Low flying height, 1 to 2 m above ground level or vegetation
- 10 inch diameter Kevlar tubes, 6 m in length
- Laser altimeter measures the sensor height to an accuracy of ±10 cm
- GPS positioning
- Magnetometer data recorded at 200 Hz
- Digital magnetic compensation procedures and software are employed to eliminate the magnetic effects of the helicopter.

Fugro UXO detection system (Fugro Airborne Surveys) 0125124

Specialised PC-based processing software allows a complete suite of geophysical products to be produced in the field. Final data are presented in digital and hard copy formats. Maps are typically presented at 1:1,200 scale, although other formats are available. Data processing can be used to generate flight lines, residual magnetic field colour contours, analytic magnetic signal colour contours, target peak map indicating geophysically inferred probable target locations, digital data and written reports.

Contractor
Fugro Airborne Surveys.

Denmark

NIRAS DEMEX

Description
Since its foundation in 1978, NIRAS DEMEX (formerly DEMEX A/S) has achieved international recognition by carrying out consulting services related to dynamics, safety, security and environmental management around the world. They have been involved in humanitarian and mine action projects, taking on work for private companies and participating in bilateral and multilateral projects on behalf of the Danish Ministry of Foreign Affairs, the UNHCR, the World Bank and the EU.

NIRAS DEMEX can offer:

- Planning and management of mine action projects;
- Risk management;
- Environmentally-friendly disposal of explosives and ammunition;
- Quality control
- Remedial action for military ranges and ammunition factories; and
- Post-war clearance and evaluation.

Contractor
NIRAS DEMEX.

NIRAS DEMEX at work in Mozambique (NIRAS DEMEX) 0074023

Netherlands

MTM

Resources
MTM (Munitions Technical Museum) is a privately-owned organisation specialising in the acquisition of inert ammunition. Their extensive premises at a disused ammunition depot in southern Holland houses what is probably the largest collection of inert ordnance in private hands. All categories of ammunition are present, with examples from countries around the world ranging from obsolete historic items to some of the most modern ordnance currently in service. MTM's landmine collection is particularly extensive, and includes virtually every type currently threatening communities in mine-affected regions. The MTM collection also includes large and rare items, such as complete Russian SA-2 and SA-3 missiles and a sectioned FROG-7 artillery rocket. On-site facilities include a well-equipped workshop, where ammunition can be dismantled and sectioned. The cutaway examples on show are made to the very highest standard, and range from the smallest fuze mechanisms to complete submunition projectiles and bombs.

Services
The MTM collection is available for viewing and instruction by arrangement. Individuals and groups involved in activities such as EOD,

Part of the MTM display facility (Colin King) 1121633

MTM logo
1121532

demining, ammunition inspection and demilitarisation can study the ordnance in a safe and comfortable environment. Inert training aids can also be provided for many ammunition types.

Contractor
MTM.

Part of MTM's mine collection (Colin King) 1327943

United Kingdom

ArmorGroup Mine Action (AGMA)

Description
ArmorGroup Mine Action conducts humanitarian and commercial mine action and EOD projects and is committed to supporting reconstruction and development in post-conflict situations. Projects are executed by engaging an integrated approach, employing techniques and resources most relevant to each deployment and individual client requirements.

Mine action and UXO clearance services are provided both on- and off-shore. They include; project management and technical consultancy; training and development of national capabilities; general and technical site survey and risk assessment; mine risk education and community relations support; landmine impact survey; quality assurance and quality control; EOD, including landmine, UXO and battle area clearance; range clearance and decommissioning; underwater UXO survey and clearance; small arms and light weapons (including man-portable surface-to-air missile systems) destruction and ammunition stockpile reduction; and arms and explosive search and access control. ArmorGroup's capabilities include the use of manual clearance methods, mechanical ground preparation systems, mine detection dogs, explosive detection dogs and underwater munitions clearance.

AGMA has provided these services for over a decade. It has operated in 24 countries including: Afghanistan, Albania, Angola, Azerbaijan, Bosnia-Herzegovina, Cambodia, Chile, Colombia, Croatia, Cyprus, Ethiopia, Iraq, Kosovo, Kuwait, Laos, southern Lebanon, Libya, Mozambique, Nepal, Poland, far eastern Russia and Senegal, Sudan and Turkey. Clients include governments, non-governmental organisations, UN agencies, the World Bank, the European Commission, national demining organisations and commercial companies.

ArmorGroup always works to country-specific and International Mine Action Standards (IMAS) and country specific standards and subscribes to the Code of Conduct of the International Red Cross and Red Crescent Movement.

ArmorGroup Mine Action deminer at work (ArmorGroup) 1041122

ArmorGroup Mine Action forms a part of ArmorGroup International plc, which has over 9,000 employees in 38 countries worldwide. As well as mine action and weapons reduction, the group provides protective security services, security training services and security consultancy services. ArmorGroup was acquired by G4S plc in May 2008.

Contractor
ArmorGroup Mine Action.

BARIC (Consultants) Limited

Description
BARIC (Consultants) Limited is a specialist company, founded in 1992, offering an independent consultancy service in all aspects of mine clearance, bomb disposal, demilitarisation and related environmental issues. The company provides general advice and detailed consultancy in subjects such as: training; project design; project management; quality management; risk assessment; environmental impact assessments; reconnaissance; documentation support; research and contract preparation.

Client needs are analysed and the best solution to meet these needs is designed. Strict confidentiality is applied to all contracts. The company provides these consultancy services for a wide range of clients including the United Nations, the European Commission, national governments and many NGOs and commercial organisations.

The company draws its expertise from a group of international specialists all of whom have extensive experience of working in many parts of the world. The selection of individuals is based on finding those best suited to the task in hand. BARIC (Consultants) Limited continues to undertake work for clients in many countries throughout the world and is fully capable of operating in difficult and hazardous environments. The company is equally capable of undertaking tasks from its offices in the UK, or from any other location a client might require.

BARIC (Consultants) Limited is ISO 9001:2000 accredited and is a corporate member of the Institute of Munition Clearance and Search Engineers.

Contractor
BARIC (Consultants) Limited.

C King Associates Ltd

Description
C King Associates Ltd (CKA) is a small company specialising in high-level consultancy on the technical and procedural aspects of mine clearance and Explosive Ordnance Disposal (EOD). The company's director is editor of *Jane's Explosive Ordnance Disposal* and *Jane's Mines and Mine Clearance*, with extensive practical experience of both military and humanitarian EOD operations.

Among their consultancy work, the company has conducted several assessments of national demining programs on behalf of the US Department of Defence and State Department, to whom it provides

recommendations for enhanced training, equipment and procedures. When highly specialist training is needed, such as the use of novel explosives, this too is provided. Assessments for the US Government have included Chad, Chile, Egypt, Jordan, Lebanon, Oman, Rwanda and Yemen. During the summer of 2003, CKA conducted a comprehensive assessment of the EOD problems throughout Iraq, which were then briefed to a wide variety of government and non-governmental organisations.

In 2001, the company conducted a complete review of the NATO EOD response to the Kosovo crisis. This was performed on behalf of the NATO EOD Working Group and involved visits to the operational EOD units of all ten countries concerned. CKA also undertakes a broad range of practical work. Recent examples have included specialist training for the US 82nd Airborne Division and trials of experimental mine clearance equipment in Cambodia, Ecuador, Kosovo and Lebanon.

CKA is licensed by the British government to hold examples of landmines for the purposes of research and analysis; their collection includes most of the anti-personnel mines currently found in mine-affected regions. The company also maintains a comprehensive image library with more than 10,000 landmine and UXO photographs from around the world.

CKA has also developed a range of landmine surrogates for training, detection trials and mechanical testing. These surrogates are currently in use with the European Joint Research Centre, US DoD, UK MOD and Japanese Government (see separate entry under *Equipment- training aids/simulators*).

C King associates Ltd

1121535

Founded to provide clear, impartial assessment on munitions and their disposal, CKA provides advice ranging from program management strategy to detailed munition disposal procedures; advice that continues to be trusted by clients in operational programs throughout the world.

Contractor
C King Associates Limited.

Consultancy, training and canine disciplines

Description
Chilport (UK) Ltd specialises in canine (K9) disciplines, training and supplying dogs for activities including search and rescue, anti-ambush, mine audits, bomb detection and narcotics detection.

A wide range of canine training courses is available including explosive detection and mine detection. In addition to supplying trained dog and providing handler training, Chilport also provide teams of trained dogs and handlers to undertake specific tasks. Handler training can be conducted at the client's location.

Contractor
Chilport (UK) Limited.

International Defence Procurement and Logistics Limited (IDPL Ltd)

Description
International Defence Procurement and Logistics Limited (IDPL Ltd) is a Private Military Company (PMC) which specialises in problem resolution and the provision of consulting services. The company was developed in 1994 as Security Systems International in Canada but became a British registered company in 2003. IDPL is a member of The International Association For Counterterrorism & Security Professionals.

IDPL provides worldwide consultation and operational services within the Explosive Ordnance Disposal (EOD), security and counter-terrorist environments. All consultants of IDPL have full military training and experience in a variety of conditions.

IDPL offers a range of services including:
- Post conflict munitions and land mine clearance
- Search of surface and sub-sea installations for explosives and other devices
- Ensuring the security of both land- and sea-based facilities, and indigenous assets and personnel
- Provide support for a wide range of engineering projects such as building construction, marine engineering and so on
- Risk analysis studies and site specific personnel briefings.

Munitions and land mine clearance
IDPL's engineers use the latest technology to survey, locate and dispose of bombs. Any suspicious object will be comprehensively investigated, its threat level identified and then disposed of appropriately to ensure the safety of the surrounding area.

Surface and sub-sea surveys
IDPL is capable of detecting explosive ordnance in a variety of situations and locations. Advanced Geophysical Systems, Magnetometers and Sonar are amongst the pieces of equipment that IDPL engineers have at their disposal for aiding detection both on land and at sea.

In the event of a marine survey not being option, IDPL's divers can provide essential back up and variety of photo and video surveys.

Securing facilities and personnel
Animal rights activists, environmental terrorism or indigenous asset protection.

Construction industry support
Recent years have seen an increase in the demand from the construction industry, and private and public sectors for IDPL's Explosive Ordnance Disposal (EOD) services. IDPL is able to provide support and assistance to a large variety of projects, including gas and oil installations and pipelines, airports and airfields, power stations, marine engineering, piling and so on.

Risk analysis studies and personnel briefings
Having carried out a full survey, IDPL's engineers can analyse the captured data and assess possible threats to business assets and/or personnel, resulting in a report clearly stating the risk and cost effective solutions to the problem.

Training
- EOD, IEDD and Landmine clearance training
- Counter insurgency operations training
- Close protection training
- Counter terrorist and anti-assassination team training.

Humanitarian operations
- Securing strategic assets – water, food, electricity, key installations
- Convoy escort
- EOD, IEDD, Landmine clearance
- Protection of aid agency personnel
- Medical support
- Air support
- Marine support.

Contractor
IDPL Ltd.

TFL Defence Limited

Description
TFL Defence Ltd (TFLD) specialises in the provision of security and protection equipment and services to support national and international organisations in munition clearance, including EOD and demining programmes, homeland security, peacekeeping and disaster relief operations. TFLD offer a wide range of bespoke security and protection packages, including training, consultancy and equipment, to meet the needs of individual clients and the various threats and environments. Backed up by international operational expertise and experience, this breadth of knowledge enables the in-house specialist staff to select the most suitable project equipment available and integrate it with the client's existing capability. Key to the delivery of the most appropriate package is close client liaison, detailed planning and whole contract support. Clients include international government and non-governmental organisations. Products range from manual hand-held prodders to vehicle mounted detection systems.

The TFLD portfolio includes the following equipment:
- Search and detection;
- Blast and ballistic barrier;
- Personal protection;
- Water supply and carriage;
- Munition neutralisation; and
- Rapid accommodation.

TFLD operates a quality management system which has been assessed to the quality system standard BS EN ISO 9001.

Contractor
TFL Defence Limited.

Top Flight Tasking remotely operated vehicles

Description
Top Flight Tasking Ltd (TFT) was formed to develop and manufacture specialist remotely operated vehicles (ROV). Projects to date have included vehicles and associated equipment for use in bomb disposal, the nuclear industry and other hazardous situations.

The company has wide experience of engineering and of both military and civil aviation. It has in-house facilities for machining, fabrication, welding, sheet metal work and electronics, and has a particular association with a specialist welding company that is approved by, and works regularly in, the nuclear industry.

Top Flight Tasking specialises in short notice, quick reaction tasks.

Contractor
Top Flight Tasking Limited.

United States

EOD Technology Inc

Description
EOD Technology Inc (EODT) is an employee-owned environmental services company, specialising in military munitions response, security related services and contaminated property development. It has been providing environmental services related to ordnance, explosives, reactives and chemical warfare material, including explosive ordnance disposal, since 1987.

Core capabilities include:

- Munitions and explosives of concern (MEC)/unexploded ordnance (UXO) disposal response;
- Improvised explosive device (IED) training;
- Information technology (IT) support;
- K-9 services;
- Site assessments and characterisation;
- Security and force protection;
- Range Services;
- Engineering;
- Mine action;
- Static security;
- Geophysics;
- Geographic Information Systems (GIS);
- Field chemistry;
- Community relations; and
- Records management.

Its MEC/UXO experts are former EOD technicians trained in all aspects of munitions response action. Its mine action programme includes manual mine clearance, mechanical demining, K-9 programmes, battle area clearance, mine risk education and training/host nation capacity building.

EODT has completed more than 500 projects and has never had a munitions-related accident. EODT has been under contract by the US Army Corps of Engineers since 1997 and has provided support to the US Army, Air Force and Marine Corps. Projects have been carried out in Afghanistan, Canada, Costa Rica, Germany, Iraq, Japan, Kuwait, Libya, Panama, Saudi Arabia and US.

Contractor
EOD Technology Inc.

Ordnance & Explosives Remediation, Inc

Description
Ordnance & Explosives Remediation, Inc (OER) undertakes a wide range of EOD related services including: geophysical investigations, Geographic Information Systems (GIS), UXO escort, investigation and removal, UXO construction support, range maintenance, Ordnance and Explosives (OE) scrap inspection and certification, OE scrap management for open, closing or closed ranges, third-party quality control and consulting and document review.

OER participated in the successful recovery of the Liberty Bell 7 capsule, Gus Grissom's Mercury space capsule that sank before recovery. A SOFAR (sound fixing and ranging) bomb was attached to the capsule, designed to detonate at a predetermined depth if the capsule sank in the ocean. Other recent projects include geophysical investigation and UXO removal at the 1,200 acre former Switzerland bomb target, St Johns County, Florida and the investigation and removal of UXO at the former Rialto Ordnance Depot in California, USA.

Contractor
Ordnance & Explosive Remediation LLC.

SOFAR recovered from the Liberty Bell 7
(The Discovery Channel)
0074421

UXB International Inc

Description
UXB International Inc has over 20 years of experience mitigating the hazards associated with:

Chemical and biological material and related highly toxic remnants of war
UXB undertakes the recovery and remediation of chemical warfare materials, toxic industrial chemicals and other hazardous materials on former defence sites, active/closing military installations and government/private properties. It conducts archival search and analysis; hazard assessments; laboratory sampling and testing; air monitoring; public outreach assistance and community co-ordination; recovery and identification; packaging, transport and disposal; emergency response; training development and instruction; and site remediation.

Homeland security
UXB supports counter-terrorism efforts, including: the decontamination of personnel, equipment and facilities; the detection and identification of

hazardous items and situations; the identification of suspicious packages and improvised devices; and the handling and disposal of contaminated, explosive or reactive materials and package hazards for transport and disposal.

Landmines/mine action
UXB is involved in the elimination of mine and unexploded ordnance hazards in order to return indigenous people to their homes; the customisation of mine action awareness programmes to country-specific requirements; and the training, organisation and equipping of national workforces to enable them to rapidly respond to mine and unexploded ordnance hazards.

Ordnance and UXO
UXB locates, maps, accesses, identifies, removes, transports and disposes of ordnance and explosives, unexploded ordnance and stockpiled munitions on land or under water. UXB creates globally positioned, permanent digital records of sites for analysing subsurface ordnance and scrap. Surveyors routinely work on sites contaminated with ordnance and explosives and use GPS receivers, electronic total stations and electronic field computer/data collectors to determine survey measurements and provide a range of maps and GIS platforms.

Range residue, munitions and energetics
UXB is addressing the ever-increasing international challenges of demilitarising range residue and munitions, ensuring that the items are free of energetics. It has developed several demilitarisation processes:

- **LOADS** — Lightweight Ordnance and Armaments Demilitarization Systems specifically engineered, designed and manufactured for demilitarising range residue and munitions.
- **UXBase^{SM}** — This process treats and destroys propellants and explosives using base hydrolysis.
- **Range Sustainment** — UXB provides a wide range of services and products that are used to maintain training and testing ranges in a manner that enables the military to safely and effectively prepare personnel, while considering environmental impact concerns.

UXB distributes a variety of equipment and products associated with its core services and has conducted operations around the world, in 44 US states and 23 countries. It has worked in remote and urban areas; in a variety of climates; in areas with little or no infrastructure; in cultural, archaeological and environmentally sensitive areas; and on base realignment and closure sites, former defence sites, active military ranges and private industrial sites.

UXB has suffered no explosive-related safety accidents since its incorporation in 1983.

UXB's LOADS system neutralises range residues and munitions
(UXB International Inc) 0573596

UXB's KIMS system collects geophysical data for subsurface mapping
(UXB International Inc) 0573597

Contractor
UXB International Inc.

HUMANITARIAN

Canada

Canadian Association for Mine and Explosive Ordnance Security (CAMEO Security)

Description
CAMEO Security is a non-profit charitable society based in Ontario, Canada. Its mission is to provide safe, professional and cost-effective mine clearance and EOD services to war-torn societies. It can deploy worldwide, at reasonably short notice, to respond to sudden threats, and will provide initial humanitarian relief as well as sustaining the capacity of the host country to conduct its own mine clearance and EOD operations in the longer term.

CAMEO Security was formed to enable direct Canadian civilian participation in the elimination of the scourge of land mines. It is to use Canadian industrial capacity to respond to the threat and is actively to seek to transfer Canadian technology to affected countries to enable them to establish and sustain their clearance programmes. The organisation uses many former Canadian Military Engineer officers and specialists and is to affiliate with other Non-Governmental Organisations (NGOs) and agencies, where required, to fulfil its mission. CAMEO's personnel have hands-on experience in mine action in Pakistan (for Afghanis), Cambodia, Kuwait, the former Yugoslavia and other small sites such as Haiti.

A wide range of services is offered, including landmine action; EOD; ancillary services for humanitarian relief operations; promoting mine awareness in Canadian schools, communities and governments; providing mine and UXO security services to other NGOs undertaking humanitarian aid and assistance to communities in hazardous areas; and assisting Canadian government initiatives in relation to the Ottawa Treaty ratification.

Contractor
CAMEO.

Senior CAMEO and OSIL personnel at Yel, Sudan (CAMEO) 0587897

CAMEO logo 0125388

United Kingdom

Institute of Munition Clearance and Search Engineers (IMCSE)

Description
The Institute of Munition Clearance and Search Engineers (IMCSE) is an international body founded in 1998 to meet the growing demand for an organisation dedicated to those working in fields related to ordnance disposal. It aims to promote the interests of the munition clearance community by establishing members' credentials through a formal accreditation process. It seeks to enhance standards of operation and safety and create an international network to improve communication within the industry. The IMCSE website (http://www.imce.org) is used to keep members informed on current issues.

The IMCSE caters for those engaged in operational work such as demining and Explosive Ordnance Disposal (EOD), weapons inspection, Improvised Explosive Device Disposal (IEDD) and Counter Terrorist Search (CTS). Different levels of membership (including affiliate, associate and student) also cater for those involved in related activities such as research and development, equipment manufacture and victim assistance. Corporate membership is also available to companies that meet the appropriate criteria.

1041214

The Institute has applied for charitable status and functions on a non-profit basis. Accredited courses are offered by training institutes for those wishing to attain recognised qualifications.

Contractor
The Institute of Munition Clearance and Search Engineers (IMCSE).

Mines Awareness Trust

Description
The Mines Awareness Trust (MAT) was established in 1999, its first project being undertaken in Kosovo. MAT is a UK charity (number: 1112738) and a Company Limited By Guarantee (LBG).

MAT's aim is to save lives and limbs through education, information and positive action in landmine, and UXO-contaminated environments. It aims to achieve this mission through community-based Mines Risk Education (MRE) and other Mines Action (MA) activities, which include technical survey, EOD/BAC and de-mining. MAT also endeavours to employ landmine survivors in its programmes.

MAT Community Liaison Officer and EOD team leader interview a community leader as part of a survey in central Kosovo (MAT) 1293441

MAT MDD centre staff with 'Firmin Sword of Peace', 2007. Also pictured is the QMSI of the IMATC, WO2 Mark Livingstone (MAT) 1293440

In 2006/07 MAT worked in the following countries:

Kosovo MAT provided Technical Survey/EOD teams to the OKPCC EOD MS, whilst also providing a Training Team, teaching the 7 KPC EOD teams Technical Survey techniques. In 2007 the teams were trained to Level 3 EOD (IMAS) standards. The KPC students undergo a 3-week course which culminates in an examination, successful students attain level 3 EOD qualifications.

Kenya MAT established a Mine Detection Dog (MDD) school within the UK-funded International Mines Action Training Centre (IMATC) in Nairobi, Kenya. The MDDs trained within the centre are intended for use in equatorial Africa in support of UN and NGO country programmes.

Uganda MAT provided Technical Advisors to the Ugandan Peoples Defence Force de-mining teams, which were trained at the International Mine Action Training Centre IMATC in Nairobi, Kenya. These teams worked under MAT supervision in surveying and clearing suspected areas in the west and northern districts. MAT also undertook GMAA of the northern areas of Uganda, compiling information on the suspected areas for clearance by UPDF de-mining teams.

Rwanda MAT provided Technical Advisors to develop the Rwandan National De-mining Office (NDO) into an effective de-mining organisation, after soldiers from the Rwandan Defence Force (RDF) undertook training and the provision of equipment at the IMATC in Nairobi, Kenya. In 2007 this training brought the strength of the NDO's de-mining teams to over 200 trained personnel. Significant headway has been made in clearing the minefields in Rwanda.

In 2008, the Mines Awareness Trust (MAT), along with the International Mine Action Training Centre (IMATC) are running Mine Action and Explosive Ordnance Disposal (EOD) courses in Nairobi, Kenya.

Contractor
Mines Awareness Trust.

United States

Golden West Humanitarian Foundation

Description

Golden West Humanitarian Foundation (established in 1998), responsible for the LEP and NMX-foam demolition systems (see separate entries), is an operational non-profit charity contributing to global mine action. The aim of the organisation is to enhance mine action programmes by providing assistance in whatever form is most beneficial. This process normally begins with a needs assessment to establish the nature of the problem, the resources available and to liaise with the co-ordinating authority and existing aid programmes.

The foundation draws on the expertise of former US and British Army explosive ordnance disposal operators and humanitarian aid workers to provide a distillation of many years experience gained from operations all over the world.

The Golden West Humanitarian Foundation has addressed programs in mine-impacted countries such as: Angola, Azerbaijan, Colombia, Guinea-Bissau, Iraq, Mozambique, Nicuagura, Vietnam and Yemen.

Mine and UXO awareness training

The foundation has sponsored a new approach to mine and UXO awareness training, in which people are taught to recognise the munitions and their signatures (such as packaging and accessories) in realistic settings. 'Mined area indicator packs' have been produced for Angola, Mozambique, Azerbaijan and Cambodia. Azerbaijan has also been provided with computers and projectors to maximise the impact of the presentations to schools and rural communities.

Explosive Harvesting System

The Explosive Harvesting System (EHS) is an R&D program to enable the safe removal of explosive from artillery projectiles, aircraft bombs, and other ordnance, then convert it into small demolition charges for the use of clearance teams.

Purchasing explosives for clearance projects can consume up to one third of an NGO's overall funding and presents a variety of logistical, shipping, and security challenges. The EHS helps reduce the cost and problems associated with importing explosives, allowing the NGOs to focus their funding on clearing more ground.

The EHS is designed as a self-contained "Field Deployable" assembly that can work in remote areas with minimal logistic support; requiring only a source of water, fuel, and a suitable location. Aside from assisting clearance programs, the system also supports stock pile reduction,

Casting new demolition charges from the recycled explosive (Roger Hess) 1041051

environmental protection, and the disposal of small arms/light weapons such as Rocket Propelled Grenades (RPGs).

The system is being developed in Cambodia by the Golden West Humanitarian Foundation with funding provided by the US DoD Humanitarian Demining Research and Development Directorate. The EHS, in its third year, is transitioning from the R&D phase of its lifecycle to operational status and will soon be deployed to other landmine impacted

countries. Since program inception, the EHS has produced 30,000 cost-effective disposal charges currently being used by both the Cambodian Mine Action Center (CMAC) and HALO Trust Cambodia.

Contractor
Golden West Humanitarian Foundation.

Projectiles that have been cut in half awaiting the removal of explosive
(Roger Hess)
1041060

Refugees International (RI)

Description
Founded in 1979, RI provides early warning and advocates early action, then continues to press for lifesaving assistance and protection during and after major humanitarian crises. The organisation makes on-the-ground emergency assessments and then uses a mixture of diplomatic leverage and media power to mobilise governments and the UN into action. Refugees International accepts no government or UN funds, allowing it to be totally objective in its assessments and unfettered in its subsequent action.

In recent years, RI has focused on issues such as refugees and internally displaced persons (IDPs), peacekeeping and conflict resolution, child soldiers, famine, women's issues, human rights of the displaced and HIV/AIDS. RI has worked throughout Africa, SE Asia, Central America, Central Asia, the Balkans and the Caucuses, and the North Korean-Chinese border.

RI recognises that landmines frequently hinder the provision of aid and the resettlement of refugees. Therefore, RI advocates against their use, both for humanitarian reasons and because of the risk to non-combatants.

Refugees International advocates travelled to the Democratic Republic of the Congo from 5th to 26th April 2008 to conduct an assessment mission on the situation of internally displaced people and the humanitarian response in eastern DRC. RI last visited the DRC in the autumn of 2007 to assess the response of the UN peacekeeping mission, MONUC, to civilian protection needs. On this current mission, RI will focus on the response by UN agencies and international non-governmental organisations to the humanitarian situation, as well as the transition to early recovery among the displaced communities in the eastern part of the country.

RI conducted assessment missions to Iraq in November 2006, February 2007, and again in February 2008 to assess the crisis and is working to bring Iraqi refugees to the attention of US officials and UNHCR.

Contractor
Refugees International.

Terra Segura International (TSI)

Description
Terra Segura International (TSI) is a non-profit, tax-exempt corporation with the mission of promoting faster, safer and more cost-effective demining. TSI is committed to finding innovative solutions to the institutional, financial, organisational, material and technological obstacles that hamper demining and ordnance removal efforts worldwide. In this way TSI saves lives, returns lands to productive use, assists economies back on the path to self-sufficiency, improves political stability and reduces threats to international security.

TSI's demining RD&E programme investigates new technologies and procedures, tests and evaluates demining products and techniques, is developing a database of signal-return profiles for mines and ordnance using different types of sensors, and designs innovative training strategies in demining, ordnance removal and logistical and maintenance support.

A technology commercialisation programme consults on technology commercialisation, distribution and application. Ploughshare Technologies has been established by TSI to deploy TSI's own patented technologies through manufacture and distribution.

TSI's technical assistance programme provides in-country programme design and management; customised, hands-on, train-the-teachers instruction in mines awareness, reporting, surveying, marking, breaching, demining and quality assurance; design and implementation of demining support infrastructure; and C'I development.

The information programme provides technical manuals and evaluation circulars for deminers and project managers, accessible communication links, updates of technical information and inexpensive, durable mines awareness information and visual aids.

TSI actively collaborates with private companies serving the demining community and with university and government laboratories, national armed forces and other governmental, multilateral and non-profit organisations engaged in demining and mine-related development activities.

Military and commercial clients and partners are currently working on acoustic sensor technology, on a sensor platform using advanced algorithms, data fusion and highly accurate global positioning and on adapting inexpensive binary chemical explosives for in-place demolition.

TSI relies predominantly on the contributions of private foundations and individuals, while applying revenues from contracting assignments and new product commercialisation to further initiatives in demining, research and development, education and information dissemination.

Contractor
Terra Segura International.

INFORMATION

Germany

LLDb-Mun Training and operational database for ammunition

Description
The LLDb-Mun network based database was designed to provide fast and reliable access to stored information. The system is flexible and data can be input and modified by the user.

The database can import and export data, allowing it to be shared with other users/nations. It can be expanded to more than 1 million data sets, including technical information for each record. Pictures, scalable graphics and GPS-controlled maps can be integrated and the system includes modules to convert measurement units and translate technical terms. A personal note organiser enables a record of lessons learnt to be maintained.

Once populated, the LLDb-Mun can be queried to assist the EOD/IED operator to identify unexploded ordnance by using a mobile assistant controlled by voice, giving the possibility of hands-free operation.

Contractor
EADS.

Sample pages of the LLDb-Mun database showing a missile (l) and a fuze (r) (EADS) 0561631

Sweden

EOD IS – Explosive Ordnance Disposal Information System

Description
EOD IS is a fully integrated database combining ammunition details, identification tools, render safe procedures and a geographical information system. It is designed to support frontline EOD teams, helping them to localise, identify, register, render safe and report mines and unexploded ordnance.

The system has been operative since mid-2000. It is in use with all branches of the Swedish armed forces and National Police Board anti-terrorist bomb groups. It has also seen active service with Swedish SFOR units in Kosovo and is used by the Swedish Navy during the annual mineclearing operations in the Baltic. As of the beginning of 2008, the Belgian Armed Forces now use the EOD IS. Austria, Denmark, Finland, Germany, Netherlands, Singapore, Slovakia, Sweden and UK are already members. France may be the next country to join.

EOD IS is 'freeware' for non-Swedish authorities and organisations within the EOD/Improvised Explosive Device Disposal (IEDD) and mineclearing community.

Contractor
Swedish EOD and Demining Centre.

United Kingdom

ASH

Description
Developed by EDS, ASH is a Explosive Ordnance Disposal information system for use by EOD teams in the field. As a fully integrated system, ASH allows operators to access up-to-date information on over 200,000 types of explosive ordnance, devices or initiators.

ASH operates on a hierarchical data model consisting of three levels, the Main Database (MD), a number of Intermediate Devices (IDs), and deployable Operator Devices (ODs). The MD is the point of entry for information on munitions and initiators and forms the core repository of EOD information. The ODs are fully ruggedized and encrypted to enhance security in operational theatres. Each level is autonomous from the other, to allow information to be assimilated and manipulated without affecting the user on the ground. Data transfer between levels is facilitated by CD or DVD, which is automatically handled by the ASH application.

When ordnance is discovered it can be identified using extensive textual and image information. The latest Render Safe Procedures can then be viewed and applied to enable safe disposal. This information can be constantly improved, as knowledge gained in the field is incorporated in the system.

ASH uses proven Commercial-Off-The-Shelf (COTS) hardware and software and provides full colour images, automatic auditing and the ability to operate over a Wide Area Network (WAN). Both servers and clients use the Windows XP operating system.

Status
In service with the Netherlands and UK armed forces.

Contractor
EDS.

EOD Frontline risk management solution

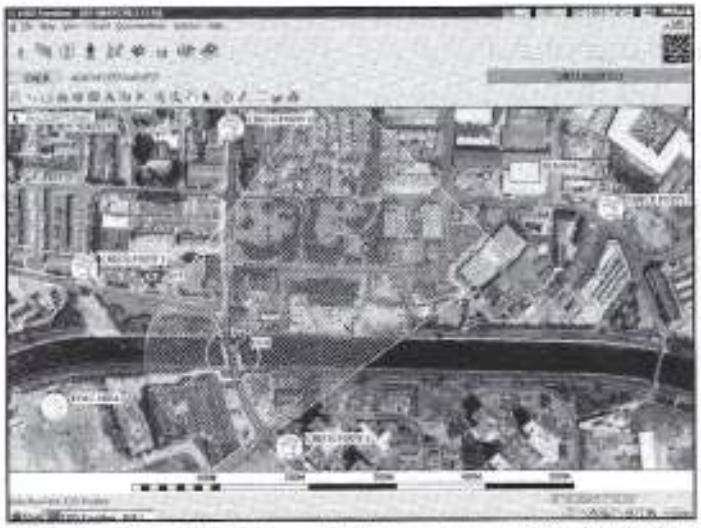
Description

EOD Frontline is a risk management battle-proven, real-time operational tool for EOD/C-IED incident management designed for use by military/civil emergency agencies to help them better prepare, protect and manage EOD incidents thus reducing the loss of lives and ensuring faster recovery.

EOD Frontline provides EOD operators with a Common Operational Picture for force protection, enabling rapid information exchange, coordination and management to aid the decision-making process across all organisational levels.

The extensive range of applications makes EOD Frontline a powerful tool for the operational tasking of incident managers providing:

- UXO/IED mission-planning, reporting and reach-back;
- blast calculations and hazard calculations for CBR and Toxic Industrial Material (TIM) contents;
- battlefield area clearance;
- post-event clearance of Explosive Remnants of War (ERW);
- sensor/robot connectivity;
- fully integrated reporting, enabling rapid communication of incident information throughout the command chain.



EOD Frontline calculates the predicted hazard area and displays it along with positions of interest (Bruhn NewTech) 0122470

EOD Frontline is designed to manage information on EOD/C-IED incidents using the NATO reporting system STANAG 2221. Data is reported or communicated in the standard formats. This facilitates the tasking of EOD teams while reporting steps taken to higher commands and ensuring a safe handover to new units. EOD Frontline can also link into other national or international reporting systems or administrative tools.

An off-the-shelf solution, EOD Frontline is available in a stand-alone version. This includes an extensive mapping module, message handling, a communications module and the capability to displaying individuals, groups and positions of interest. EOD Frontline can also be integrated in Command and Control systems. Further expansion and integration capabilities include integration of detectors and interface to vehicle and robot (ROV) systems.

Status

As of early 2008, EOD Frontline is in operational use with military forces, including the UK Armed Forces, current NATO and UN missions, and police, fire services and rescue organisations. EOD Frontline has also been used for post-conflict clear-up in Lebanon, Afghanistan and Iraq.

Contractor

Bruhn NewTech Limited.

Data entry is user-friendly (Bruhn NewTech) 0122471

Military Ordnance Design CD-ROM databases

Description

Military Ordnance Design specialises in databases for the military, security forces and police. The databases cover a wide variety of weapons, ammunition and related subjects broken down into logical parts. Each database stands on its own but is related to the others by a unique numbering system. Regular updates ensure that the latest information is available. The databases are normally supplied on CD-ROM and are available either as a single subject or in any combination.

Bombdex™

A series of databases that cover many forms of ordnance and related items divided into groups by content.

- Mines: covering land and sea mines. Dimensions, filling and fuzes are fully detailed
- Detonators: all forms of detonators including wire, plug and body markings/colours where possible
- Explosives: characteristics of explosives, chemical content, typical use, country of origin and other reference sources. Can be used to identify one particular explosive or review details of a group of explosives with common characteristics. Also includes pyrotechnic compounds and propellants
- Fuzes: full data, where possible, includes characteristics of the item, the charge and propellant, typical use, country of origin and further reference sources
- Grenades: includes, where possible, dimensions, characteristics of the item, the charge, typical use, country of origin and further reference sources
- Bombs: includes, where possible, characteristics of the item, the charge, fuze details, typical use, country of origin and further reference sources
- Missiles: includes, where possible, characteristics of the missile, the charge and propellant, typical use, country of origin and further reference sources
- Chemical and biological agents: details include identification features and symptoms.

Gundex™

This is a database containing many forms of small arms including details of the weapon, users, operation, history and forensic data. The ammunition details can be expanded by the use of the companion database Ammodex™.

Ammodex™

A series of databases that covers many forms of ammunition and related items. It is divided into four groups by content, each a stand-alone database but interrelated where appropriate.

- Small: up to 13 mm
- Large and Separate Loading: over 13 mm, both fixed and separate loading
- Mortars
- Headstamps: Headex™ is a pictorial database. It can be used to identify one particular headstamp from known data or to review the details of a group of headstamps.

Other databases include an Incident Reporting System, used to complete incident report forms to ensure the information is accurate and complete, and the FEEM Security Identification Guide for the identification of explosives and detonators produced in Europe.

Status

No longer available.

Contractor

Military Ordnance Design Limited.

MEDICAL

Norway

Trauma Care Foundation

Description
The Trauma Care Foundation is a small organisation run by physicians with considerable experience of mine-related traumatic injuries. The number of mine victims they receive frequently overwhelms the few centralised medical facilities in developing countries, and many die or seriously deteriorate during the long journeys to the centres. Realising the limitations of current facilities, the foundation seeks to provide indigenous personnel with the skills necessary to save mine victims. Students are put through an intensive training programme beginning with basic first-aid skills, which culminates in the actual administration of anaesthetics and the performance of live surgical procedures.

By the end of the course, most students have performed operations that are rarely encountered by surgeons in routine practice. Successful students are equipped with trauma packs that allow them to address the majority of the injuries they are likely to encounter. The result is a network of skilled emergency medical care, located in the communities where it is most needed.

In 1999, the Trauma Care Foundation's programmes in Cambodia and northern Iraq were adopted by the World Health Organisation in Geneva as model programmes for pre-hospital mine-victim assistance in minimum-resource areas. The Trauma Care Foundation also runs the Tromsø Mine Victim Resource Centre (see separate entry).

The Trauma Care Foundation and partners are currently operating rural trauma systems in Cambodia, Iraq, Afghanistan, Nepal and Vietnam.

Contractor
Trauma Care Foundation.

Tromsø Mine Victim Resource Center

Description
The Tromsø Mine Victim Resource Center is a World Health Organisation Associated Center conducting research and developing guidelines for improved trauma care with special reference to landmine and other victims of conflict. The Center is conducting pilot programmes for mine-victim assistance in Afghanistan, Cambodia, northern Iraq and Vietnam in co-operation with the Trauma Care Foundation.

The Center produces and distributes the following teaching aids for trauma management training programmes at pre-hospital and district hospital level:

- *Save Lives, Save Limbs*: A manual detailing basic and advanced in-field life support to victims of mines, war and accidents. 250 pages, 450 illustrations. Editions are available in English, Farsi, Burmese, Khmer, Kurdish, Spanish and Portuguese;
- *War Surgery, Field Manual*: A comprehensive manual relating to life-saving surgery under minimum-resource conditions. 800 pages, 1,400 illustrations. Editions are available in English and Farsi;
- Comprehensive documentation of land mine injuries; and
- Instruction video for trauma life support training.

Contractor
Trauma Care Foundation.

South Africa

Field Medical Support Unit

Description
The Field Medical Support Unit is a rapidly deployable medical facility specifically designed for use by demining, EOD and armed forces medical personnel. Ideal for use in remote locations, it comprises a self-contained unit that can function independently of any outside source or infrastructure for prolonged periods. The unit is rapidly deployable by helicopter, cargo aeroplane or light truck and is custom built into a 6 × 3 m thermally insulated, lightweight, dust proof, fireproof and seaworthy container. Electricity is provided by solar panels and the unit is equipped with lights and a fridge. A wash basin, water pump, water tank and waste water container are also provided. Internally, the unit is fully equipped with examination couches, stretchers, trauma kits (see separate entry) and the necessary storage and other ancillary equipment.

The Field Medical Support Unit provides a versatile infrastructure that can be adapted to provide a range of services, either alone or in combination including: general sick bay/clinic, minor surgical theatre, forward medical base, medical base in support of demining or peacekeeping operations or for use in temporary or emergency civilian situations.

Status
No longer in production.

The Field Medical Support Unit with solar panels and side tent 0056169

Contractor
Tactical Medical Developments CC.

Trauma Kit and Mini Trauma Kit

Description
Tactical Medical Developments manufactures the Trauma Kit and Mini Trauma Kit, which are specifically designed for use in the pre-hospital resuscitation phase of major injuries arising in a military environment. These injuries typically include those caused by high velocity missiles, mortars, artillery shells, landmines and vehicle accidents.

The kit contains 50 items required to treat and stabilise victims at the scene of an incident, thereby increasing chances of survival. Although very comprehensive, the Trauma Kit is user-friendly, with the contents arranged in three modules that are used in sequence during resuscitation.

The Trauma Kit contains sufficient equipment to simultaneously treat two patients suffering from life-threatening injuries, or between three and five patients suffering from less severe injuries.

For details of the latest updates to *Jane's Explosive Ordnance Disposal* online and to discover the additional information available exclusively to online subscribers please visit **jeod.janes.com**

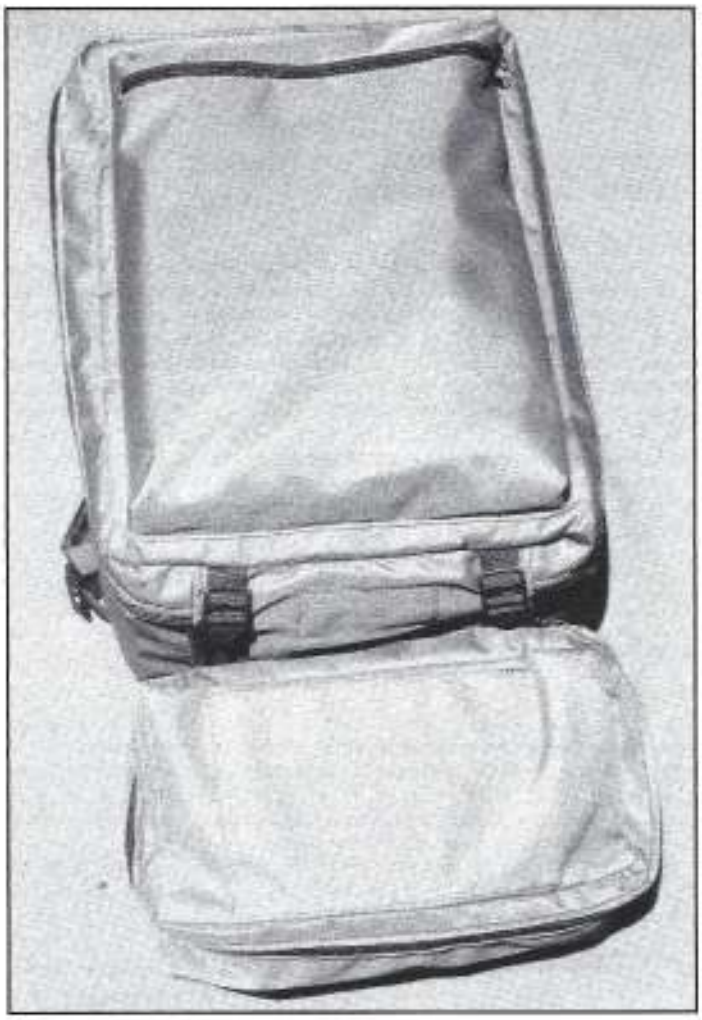
The kit is intended to be used by groups or units who are exposed to a high risk of serious injury, particularly where medical facilities are lacking or unavailable – these include special forces, fast moving land forces and demining engineers.

Supplied in a waterproof backpack, the kit weighs 11 kg fully packed, and can be easily stored in any vehicle or helicopter.

The Mini Trauma Kit is a scaled down version of the Trauma Kit, having a combination of all three modules. It is designed to be carried by individual operators, weighs 1.4 kg, and is supplied in a waterproof carry bag that may be attached to the bottom of the Trauma Kit if required.

Status
In production.

Contractor
Tactical Medical Developments CC.



Trauma Kit with Mini Trauma Kit attached
0021482

United States

Meridian auto-injectors

Description
Meridian offers a broad range of auto-injector drug delivery systems and drug formulations for emergency medical use.

Each auto-injector is a pre-filled, self-contained, pressure-activated system designed for the quick administration of precise dose of medication. Unlike a syringe, which can be cumbersome and time-consuming, auto-injectors provide a compact, quick and portable delivery system suitable for self or buddy aid.

Training simulators are available for many of the products. These devices are designed to be similar in appearance and function to the products they mimic. However, they do not contain a needle or any medication, and can be reset after activation for repeated educational demonstration.

Products include: AtroPen® 2 mg, 1 mg, 0.5 mg, and 0.25 mg auto-injectors, ATQX™ ComboPen®, atropine and obidoxime chloride auto-injector, Pralidoxime Chloride 600 mg auto-injector, Mark I™ Nerve Agent Antidote Kit, Antidote Treatment Nerve Agent Auto-Injector, (ATNAA) atropine and pralidoxime chloride auto-injector, Diazepam 10 mg auto-injector (diazepam injection; C-IV), and Morphine 10 mg auto-injectors (morphine injection; C-II).

Contact details
Meridian Medical Technologies™ Ltd (UK) – a subsidiary of Meridian Medical Technologies™, Inc.

The complete range of Meridian auto-injectors
(Meridian Medical Technologies)
0587891

TRAINING

Czech Republic

University of Pardubice, Institute of Energetic Materials

Description
The Institute of Energetic Materials at the University of Pardubice offers education to MSc and PhD level in the following subjects:

- Military explosives technology
- Analysis and testing
- Pyrotechnics
- Industrial applications of explosives
- Safety engineering.

The Department is also able to offer a consultancy service specialising in explosives research and application.

Contractor
University of Pardubice.

United Kingdom

Allen-Vanguard

Description
Allen-Vanguard has been a major supplier and manufacturer of explosive ordnance disposal (EOD) equipment for more than 30 years. To ensure effective deployment of the equipment supplied, the company offers the professional user a wide range of training packages; each of which tailored to meet the client's requirements. Training can be arranged in the UK or in-country as appropriate.

Training can take many forms; for example equipment training on a single new product, or everything from operational protocols, doctrines, personnel, equipment, logistics support and an ongoing training programme for a new team or force.

Training can be provided in the following disciplines:

- Equipment training: correct operation and maintenance of equipment manufactured and supplied by Allen-Vanguard
- Search training: high-risk counter-terrorist search and contraband search
- Bomb awareness and counter-measurers: tailored either for corporate customers or security forces
- Threat analysis and planning: intended primarily for security forces
- Improvised Explosive Device Disposal (IEDD): training in operational procedures, exclusively aimed at recognised security forces.

Allen-Vanguard published its first ever educational HAL® Manual in 2001. Named 'HAL® Tactical Procedures Manual' (NATO Stock Number: 7610-99-212-6532) it contains multiple EOD disposal scenarios and provides a practice guide for EOD/bomb technicians.

Contractor
Allen-Vanguard (formerly PW Allen & Company Limited).

Training is one of Allen-Vanguard's specialities (Allen-Vanguard) 1154142

Allen-Vanguard offers a wide range of training (Allen-Vanguard) 1154143

Institute of Explosives Engineers (IExpE)

Description
The Institute of Explosives Engineers was established in 1974 to represent the users of explosives. Initially the membership was drawn from the UK, but the IExpE now includes members from Europe, the Middle East, Hong Kong and Australia. The members are drawn from all professions where explosives are used, made or handled; from the major manufacturers to research laboratories, from oil well operators to firework display makers and from ammunition technicians to special effects practitioners.

As well as Company Membership and Honorary Fellowship, there are four grades of membership: Student, Associate, Member and Fellow. Each grade of membership is open to suitably qualified persons engaged in any area of explosives work, the higher grades being achieved by either examination or by adequate demonstration of professional standing. There are currently eight specialist examinations for users of explosives; papers relating to Explosives Related Security Matters are in development.

The Institute aims to provide a common forum where the needs, aspirations, fears and apprehensions of all the various groups can be aired, and where their particular knowledge can be pooled for mutual benefit. It is not unusual for the solution to a problem to come from an area of work completely alien to the problem itself, and the Institute provides a mechanism by which this can be achieved. The committee structure of the IExpE enables effective liaison with UK government departments, including the Health and Safety Executive and the British Standards Institute, as well as other professional bodies and trade associations. Further afield, the Institute plays a major role as a key member of the European Federation of Explosives Engineers (EFEE).

The IExpE is committed to education and training in order that the professional status of its members is maintained and recognised. The Institute set up the Education and Research Trust, one of whose aims is to promote the education of all persons involved with the use of explosives, at whatever level they work at.

Contractor
Institute of Explosives Engineers.

International School for Security and Explosives Education (ISSEE)

Description
The International School for Security and Explosives Education (ISSEE) delivers training to students from a number of backgrounds including: Armed Forces, Police and Commercial members of the international and armed forces, civilians and police officers in compliance with the most stringent standards. ISSEE courses enable students to achieve City and Guilds qualifications and are delivered by former British armed forces and police subject matter specialists.

Training can be given in the following subjects:

- Explosives storage management
- Explosives foundation
- EOD
- Improvised Explosive Device awareness
- Improvised Explosive Device Disposal
- Introduction to manual techniques
- Explosive ordnance search
- High-risk search
- Person search
- Building search
- Counter-terrorism
- Security threat assessment
- Corporate security.

The school is a recognised provider of search, counter-terrorism, security and explosives resettlement training to UK military service leavers through the Career Transition Partnership.

ISSEE students go on to perform a variety of roles including Counter Terrorist activities, EOD, humanitarian mine and related activities. All subject streams have a structured pathway that allows flexible access and recognises the varying backgrounds of the students. Courses can be delivered at any suitable location around the world and courses can be tailored to suit training needs.

ISSEE has an international client base and has delivered training to customers from US, UK, Europe, KSA, UAE, Oman, Qatar, Kuwait, Singapore, Brunei, China, Malaysia, Montenegro, Latvia, Sweden and Dubai.

Contractor
International School for Security and Explosives Education.

AB Precision 'Cyclops' Miniature Remotely Operated Vehicle being demonstrated to members of the World EOD Foundation (ISSEE) 0567425

SDMS

Description
SDMS offers EOD and bomb disposal training using instructors formerly serving with specialist units of the British Army such as the Special Forces, Royal Engineers and former Royal Army Ordnance Corps. It has experience of training numerous overseas government personnel in these skills.

Contractor
SDMS Security Products Limited.

UK Military & Police Canine Training Centre

Description
The UK Military & Police Canine Training Centre (MPCTC) is a non-governmental organisation (NGO) founded and operated by ex-military personnel. MPCTC supplies drugs and explosive detection dogs and a handler service on contract to police forces in the UK, and to police and armed forces around the world.

Contractor
UK Military & Police Canine Training Centre.

United States

Counter-terrorism and explosives training

Description
These training materials are designed to help bomb technicians conduct initial training for security personnel, first responders and the general public on basic explosives handling and accident prevention.

The Pickett's Primer training series includes four videotapes and a book:

- Volume 1 – Commercial Explosives
- Volume 2 – Military Ordnance
- Volume 3 – Bomb Threats and Bomb Scares
- Volume 4 – Weapons of Mass Destruction
- Book – Explosives Identification Guide.

Instructor guides are also included.

The series presents a self-contained training programme on how to identify a variety of explosives; and what to do when they are discovered. The book is an easy-to-understand reference for people unfamiliar with explosives. It includes photographs and descriptions of explosives, guidelines for responding to bomb threats and conducting bomb searches, and a bomb threat checklist.

Contractor
Pickett's Video and Training LLC.

EOD Technical Solutions

Description
Sparta Inc EOD Technical Solutions (ETS) Division provides training to EOD and public bomb squad units in relation to improvised explosive device (IED) and weapons of mass destruction (WMD) threats. Dedicated mobile training teams provide professional instruction in threat assessment, incident task management, IED electronics, advanced diagnostics and defeat. Curriculum development, tabletop and field training exercises, and the devices on offer are tailored to specific client requirements. Devices are realistic, affordable, inert training aids complete with monitoring systems for enhanced diagnostics and precise render safe procedures.

ETS training exercise
(Sparta, Inc)
0074820

Now available is the Zeus™ Tactical Laser System, a 1 kW laser mounted on an armoured HMMWV, intended for use in a range of scenarios, including those involving surface-laid mines and unexploded ordnance (UXO), and defeating IEDs from a distance. Zeus™ has been effective in destroying UXO, ranging from cluster bombs up to 155 mm projectiles.

Cobham announced on 16 January 2008 that it intends to acquire Sparta Inc for USD416 million.

Contractor
Sparta, Inc, ETS Division.

Zeus™ laser system for UXO disposal
(Sparta, Inc)
0074821

First responder and awareness training

Description
American Innovations Inc supply first responder and awareness training covering x-ray interpretation, security checkpoint and threat awareness.

Training programs include preliminary training, follow-up training, and red cell exercises to test skills and identify security gaps.

All American Innovations courses include hands-on exercises, role playing with scenarios designed to improve observation skills, recognition of threats, and techniques to enhance x-ray screening equipment efficiency. The company use their own training aids which simulate potential threats and improve recognition of the components used to make them.

X-ray interpretation training
American Innovations Inc's x-ray image analysis training courses were created to enhance x-ray operator performance for cargo screening, baggage screening, and mailroom screening applications. The training courses help x-ray operators enhance their performance through a multilayered approach, starting with an overview of how x-ray screening systems work. Also covered is the difference between colour and greyscale images, techniques for overcoming perception of what's in an x-ray image, how to identify anomalies, and techniques for increasing awareness toward behaviours that might signal threats.

Security checkpoint training
On this course, an attendee will learn how x-ray machines and metal detectors work and how they can be defeated, how to select and use hand-held metal detectors to perform pinpoint searches, how to use advanced x-ray image analysis techniques to improve screening and ways to be aware of behaviours that might signal a threat. This training course teaches operators various techniques to maximise efficiency of security checkpoint technologies.

Threat awareness training
The course shows how to identify and respond to threats and have a basic understanding and awareness of behaviour pattern recognition and common items and situations that might be an act of terrorism in the making. Students will learn statistics and awareness of international and US terrorist organisations, threat awareness toward explosives and weapons incorporating chemical, radiation, and biological components, behaviour recognition techniques, identification techniques with appropriate actions to take if threat is suspected or found, profiles in terrorism, and how to prepare for terrorist attacks.

Contractor
American Innovations Inc.

DATA SUMMARY

Munitions inventories

Production
HE bombs
Cluster bombs and dispensers
Other bomb types
Air-to-air missiles
Air-to-surface missiles
Air-launched rockets
Submunitions

MUNITIONS INVENTORIES

These tables list some of the major munition categories and types believed to be in service, or stockpiled, with national armed forces. The tables are intended to indicate the main weapon systems and categories of unexploded ordnance that might be encountered after conflicts involving these countries.

The munition categories listed are:

SAM: Surface-to-Air Missiles
AAM: Air-to-Air Missiles
ASM: Air-to-Surface Missiles
Bombs: free-fall air-delivered ordnance
Rockets – air: air-launched rockets
Rockets – ground: Artillery Rocket Systems (ARS) and Multiple Rocket Systems (MRS)
Anti-tank: anti-tank missiles and rockets.

Notes

1. Russian missiles are referred to using their NATO designation and nickname (for example, SA-7 'Grail'). These can be identified and cross-referenced with their Russian designators using the tables in the *Missiles* section. Russian rockets are referred to by their Russian designation and name (for example, BM-21 'Grad').
2. Entries such as AIM-9 Sidewinder and RPG-7 refer to a weapon system, and may indicate the presence of several variants, related munitions or warhead options.
3. Detailed descriptions of the weapon systems and individual munitions can be found in *Jane's Air-Launched Weapons, Jane's Armour and Artillery, Jane's Infantry Weapons* and *Jane's Land-Based Air Defence*.
4. The types of mines likely to be encountered in each country are listed in *Jane's Mines and Mine Clearance*.

Afghanistan

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Blowpipe	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	S-5 57 mm	122 mm BM-21 'Grad' MRS	73 mm SPG-9
FIM-92A Stinger	AA-6 'Acrid'	AS-9 'Kyle'	BRAB AT	UB-16 57 mm Pod	140 mm BM-14-17 MRS	82 mm RCL B-10
HN-5A	AA-7 'Apex'	AS-10 'Karen'	FAB GP	UB-32 57 mm Pod	220 mm BM 9P140	AT-3 'Sagger'
SA-2 'Guideline'	AA-8 'Aphid'	AS-12 'Kegler'	FAB-M43	S-8 80 mm	'Uragan' MRS	RPG-7
SA-3 'Goa'	SA-7 'Grail'	AS-14 'Kedge'	FAB-M46	B-8V20A 80 mm Pod		
SA-7 'Grail'	SA-14 'Gremlin'	AT-2 'Swatter'	FAB-M54	S-13 122 mm		
SA-13 'Gopher'		AT-3 'Sagger'	KMG-U Dispenser	BL13L 122 mm Pod		
SA-14 'Gremlin'		AT-6 'Spiral'	RBK-250-275 cluster	S-24 240 mm		
SA-16 'Gimlet'			ZAB Incendiary			

Albania

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
HQ-2A	PL-2/3		100 kg GP Type 1	57 mm Type 1 and 2	107 mm Type 63 MRS	82 mm RCL T21
SA-7 'Grail'	PL-5		250 kg Low Drag	HF-16B Pod		RPG-7
			250 kg Type 1			
			HE Incendiary			
			250 kg Type 1			
			Incendiary			
			250 kg Type 2 GP			

Algeria

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-3 'Goa'	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	S-5 57 mm	122 mm BM-21 'Grad' MRS	73 mm SPG-9
SA-6 'Gainful'	AA-6 'Acrid'	AS-9 'Kyle'	BRAB AT	UB-16 57 mm Pod	140 mm BM-14-16 MRS	AT-3 'Sagger'
SA-7 'Grail'	AA-7 'Apex'	AT-2 'Swatter'	FAB GP	UB-32 57 mm Pod	220 mm 'Uragan' MRS	AT-4 'Spigot'
SA-8 'Gecko'	AA-8 'Aphid'	AT-3 'Sagger'	FAB-M43	S-8 80 mm	240 mm BM-24 MRS	AT-5 'Spandrel'
SA-9 'Gaskin'	AA-10 'Alamo'	AT-6 'Spiral'	FAB-M46	B-8V20A 80 mm Pod	300 mm 'Smerch' MRS	
SA-13 'Gopher' (unconfirmed reports)	AA-11 'Archer'	ZT-35 Ingwe	FAB-M54	S-13 122 mm	FROG-7 ARS	
	SA-7 'Grail'		KMG-U Dispenser	B-13L 122 mm Pod		
			ZAB Incendiary	S-24 240 mm		

Angola

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline'	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	S-5 57 mm	122 mm BM-21 'Grad' MRS	73 mm SPG-9
SA-3 'Goa'	AA-7 'Apex'	AS-9 'Kyle'	BRAB AT	UB-16 57 mm Pod	122 mm RM-70 MRS	82 mm RCL B-10
SA-6 'Gainful'	AA-8 'Aphid'	AS 12	FAB GP	UB-32 57 mm Pod	140 mm BM-14-16 MRS	107 mm RCL B-11
SA-7 'Grail'	SA-7 'Grail'	AS 15	FAB-M43	S-8 80 mm	240 mm BM-24 MRS	RPG-2
SA-8 'Gecko'		AT-2 'Swatter'	FAB-M46	B-8V20A 80 mm Pod		RPG-7
SA-9 'Gaskin'		AT-3 'Sagger'	FAB-M54	S-13 122 mm		AT-3 'Sagger'
SA-13 'Gopher'		AT-6 'Spiral'	KMG-U Dispenser	B-13L 122 mm Pod		
SA-14 'Gremlin'		HOT	ZAB Incendiary	S-24 240 mm		
SA-16 'Gimlet'						

Argentina

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Blowpipe	AIM-9 Sidewinder	AM 39 Exocet	BK-BR GP	Aspide 1057	105 mm Pampero MRS	75 mm RCL M20
RBS-70	R530	AS 12	BRP-BRPS-FAS	CBAS-1 Albatros	127 mm CP3 MRS	89 mm RL M65
Roland 2	R550 Magic	Martin Pescador	BAP 100	Mamboretta 657 Pod	127 mm SAPBA MRS	90 mm RCL M67
SA-7 'Grail'	Shafrir II	Mathogo	BAT 120	68 mm SNEB	160 mm LAR-160 MRS	105 mm RCL M1974
Tigercat		MP 1000	BLG 66 Belouga	Multi-Dart 68 mm		CIBEL-2K ATGW
			Durandal	Multi-Dart 100 mm		SS11, SS12 ATGW
			Mk 7 Dispenser (Rockeye)	Matra Pods		

Armenia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline'	AA-2 'Atoll'	AT-2 'Swatter'	FAB GP	B-8V20A 80 mm Pod	122 mm BM-21	73 mm SPG-9
SA-3 'Goa'	AA-8 'Aphid'	AT-3 'Sagger'		B-13L 122 mm Pod	'Grad' MRS	AT-3 'Sagger'
SA-4 'Ganef'	SA-7 'Grail'	AT-6 'Spiral'		S-5 57 mm	273 mm WM-80 ARS	AT-4 'Spigot'
SA-7 'Grail'				S-8 80 mm		AT-5 'Spandrel'
SA-8 'Gecko'				S-13 122 mm		RPG-7
SA-9 'Gaskin'				UB-16 57 mm Pod		RPG-18
SA-13 'Gopher'				UB-32 57 mm Pod		
SA-14 'Gremlin'						
SA-16 'Gimlet'						

Australia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-43 Redeye	AIM-7 Sparrow	AGM-84 Harpoon	GBU-10	CRV7		66 mm LAW
RBS-70	AIM-9 Sidewinder	AGM-88 HARM	GBU-12	Hydra 70		84 mm Carl Gustaf
Rapier	ASRAAM	AGM-158 Jassm	GBU-15	LAU-5002 Pod		106 mm RCL M40
	AIM-120	AGM-114 Hellfire	Mk 81/82/84 GP	LAU-61 Pod		MILAN ATGW
		AGM-142E	Mk 7 Dispenser	LAU-68 Pod		
		Have Nap	(Rockeye)	TDA 68 mm		
		Penguin Mk 2	Paveway II LGB			
		Mod 7				

Austria

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Mistral	AIM-9 Sidewinder		M 71 Virgo	Hydra 70		66 mm LAW
			Swedish Low Drag	CRV7		84 mm Carl Gustaf
						106 mm RCL M40
						Panzerfaust 3
						RBS 56 BILL ATGW

Azerbaijan

SAM	AAM	ASM	Bombs	Rockets -air	Rockets – ground	Anti-tank
SA-2 'Guideline'	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	B-8V20A 80 mm Pod	122 mm BM-21	73 mm SPG-9
SA-3 'Goa'	AA-6 'Acrid'	AS-9 'Kyle'	BRAB AT	S-5 57 mm	'Grad' MRS	AT-3 'Sagger'
SA-4 'Ganef'	AA-8 'Aphid'	AS-10 'Karen'	FAB GP	S-8 80 mm		RPG-7
SA-5 'Gammon'	SA-7 'Grail'	AS-11 'Kilter'	KhAB Chemical	UB-16 57 mm Pod		RPG-18
SA-7 'Grail'		AS-12 'Kegler'	KAB-500L	UB-32 57 mm Pod		
SA-8 'Gecko'		AS-13 'Kingbolt'	KAB-500 Kr			
SA-9 'Gaskin'		AS-14 'Kedge'	RBK-250/275 Cluster			
SA-13 'Gopher'		AT-2 'Swatter'	RBK-500 Cluster			
SA-14 'Gremlin'		AT-3 'Sagger'	ZAB Incendiary			
SA-16 'Gimlet'		AT-6 'Spiral'				

Bahrain

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Crotale	AIM-7 Sparrow	AS 11	Mk 81/82/84 GP	Hydra 70	227 mm MLRS	106 mm M40A1
FIM-92A Stinger	AIM-9 Sidewinder	AS 12		LAU-130/A Pod		120 mm RCL Mobat
I-HAWK	AIM-120 AMRAAM	AGM-65 Maverick		LAU-131/A Pod		TOW ATGW
RBS-70		BGM-71 TOW		M260 Pod		
				M261 Pod		

Bangladesh

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
HN-5A/B	AA-2 'Atoll'		100 kg GP Type 1	57 mm Type 1 and 2	Chinese MRS	106 mm RCL M40
QW-2	AA-8 'Aphid'		250 kg GP Type 2	HF-16B Pod		
	AA-10 'Alamo'					
	PL-2					
	PL-5					

Belarus

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline'	AA-6 'Acrid'	AS-7 'Kerry'	AO Frag	B-8V20A 80 mm Pod	122 mm BM-21	73 mm SPG-9
SA-3 'Goa'	AA-7 'Apex'	AS-10 'Karen'	BetAB	M-100 135 mm	'Grad' MRS	AT-3 'Sagger'
SA-5 'Gammon'	AA-8 'Aphid'	AS-11 'Kilter'	BRAB AT	S-5 57 mm	220 mm BM 9P140	AT-4 'Spigot'
SA-7 'Grail'	AA-9 'Amos'	AS-12 'Kegler'	FAB GP	S-8 80 mm	'Uragan' MRS	AT-5 'Spandrel'
SA-8 'Gecko'	AA-10 'Alamo'	AS-13 'Kingbolt'	FAB-M54 GP	UB-16 57 mm Pod	300 mm BM 9A52	AT-7 'Saxhorn'
SA-10 'Grumble'	AA-11 'Archer'	AS-14 Kedge'	FAB-M62 GP	UB-32 57 mm Pod	'Smerch' MRS	RPG-7
SA-11 'Gadfly'	SA-7 'Grail'	AT-2 'Swatter'	KhAB Chemical		FROG-7 ARS	RPG-18
SA-12 'Gladiator'	SA-14 'Gremlin'	AT-3 'Sagger'	OFAB			
SA-13 'Gopher'		AT-6 'Spiral'	RBK-500 Cluster			
SA-14 'Gremlin'			ZAB Incendiary			
SA-15 'Gauntlet'						
SA-16 'Gimlet'						
SA-18 'Grouse'						

Belgium

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
I-HAWK	AIM-9	AGM-65 Maverick	GBU-24	FZ-70 70 mm		66 mm LAW
Mistral	Sidewinder	BGM-71 TOW	Paveway III	HMP-RL		MILAN ATGW
	AIM-120		GBU-12, GBU-10	RMP		Swingfire ATGW
	AMRAAM		Paveway II	Zuni 130 mm		
			GBU-31 JDAM			
			Mk 81/82/84 GP			

Belize

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
						84 mm Carl Gustav

Benin

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'						RPG-7
SA-9 'Gaskin'						

Bolivia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
HN-5				Hydra 70		106 mm RCL M40A1
				M260 Pod		
				M261 Pod		

Bosnia-Herzegovina

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline'	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	VRZ-57 HE 57 mm	122 mm APRA MRS	82 mm M60A
SA-7 'Grail'	SA-7 'Grail'	AS-9 'Kyle'	FAB GP	Lanser L-57-16MD	122 mm BM-21	90 mm M79
SA-9 'Gaskin'		AT-2 'Swatter'	KPT-150 dispenser	Pod	'Grad' MRS	120 mm RBR M90
SA-14 'Gremlin'		AT-3 'Sagger'		VRZ-127 HE 127 mm	128 mm M63 MRS	RB M57
SA-16 'Gimlet'		AGM-65 Maverick		Lanser L-128-04 Pod	128 mm Plamen-S MRS	
SA-18 'Grouse'				5 in HVAR	262 mm M-87 'Orkan' MRS	
					FROG-7 ARS	

Botswana

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Javelin			227 kg GP	68 mm SNEB	122 mm APRA MRS	84 mm Carl Gustaf
SA-7 'Grail'				Matra F4 Pod		RPG-7
SA-16 'Gimlet'				SURA 80 mm		TOW ATGW

Brazil

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Mistral	AIM-9	AM 39 Exocet	AV-BAFG	LAU-3	108 mm FGT 108R MRS	3.5 in RL M20
Roland 2	Sidewinder	ARM	AV-BI	LM-37 Pod	127 mm SS-30 (ASTROS II)	57 mm RCL M18
SA-16 'Gimlet'	Derby	AS 11	AV-BP 250	LM-70 Pod	180 mm SS-40 (ASTROS II)	75 mm RCL M20
SA-18 'Grouse'	MAA-1	AS 12	BADI	LM-127 Pod	300 mm SS-60 (ASTROS II)	106 mm RCL M40A1
	Piranha	Sea Skua	BAP 100	SBAT-37	300 mm SS-80 (ASTROS II)	84 mm Carl Gustaf
	Python 3		BAT 120	SBAT-70		84 mm AT4
	R530		BFA-230/2	SBAT-127		Eryx ATGW
	R550 Magic		BLG-120	Skyfire		BILL ATGW
			BLG-252			Cobra ER44 anti-tank
			Durandal			weapon system

Brunei

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Mistral		AM 39 Exocet	BL 7 115 kg GP			Armbrust LAW
Rapier		HOT	BL 9 120 kg Frag			SS-11 ATGW
			SEI 227 kg			

Bulgaria

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline'	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	B-8V20A 80 mm Pod	122 mm BM-21	73 mm SPG-9
SA-3 'Goa'	AA-3 'Anab'	AS-10 'Karen'	BetAB	LR-122 Pod	'Grad' MRS	82 mm RCL B-10
SA-4 'Ganef'	AA-7 'Apex'	AS-11 'Kilter'	BRAB AT	M-100 135 mm	132 mm BM-13 MRS	AT-3 'Sagger'
SA-5 'Gammon'	AA-8 'Aphid'	AS-12 'Kegler'	FAB GP	ORD-57 Pod	FROG-7 ARS	AT-4 'Spigot'
SA-6 'Gainful'	AA-10 'Alamo'	AS-14 'Kedge'	FAB-M54 GP	ORO-57KM Pod		AT-5 'Spandrel'
SA-7 'Grail'	AA-11 'Archer'	AT-2 'Swatter'	FAB-M62 GP	S-5 57 mm		ATGL-L
SA-8 'Gecko'	SA-7 'Grail'	AT-3 'Sagger'	OFAB 100/120	S-8 80 mm		ATGL-L1
SA-9 'Gaskin'		AT-6 'Spiral'	OFAB 100/250	UB-16 57 mm Pod		ATGL-L2
SA-10b 'Grumble'			OFAB 250/270	UB-32 57 mm Pod		ATGL-H
SA-11 'Gadfly'			P-50-75 Practice			ATGL-H2
SA-13 'Gopher'			RBK-500 Cluster			RPG-7

Bulgaria — *continued*

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-14 'Gremlin' SA-16 'Gimlet'			ZAB Incendiary			

Burkina Faso

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'			BL 7 115 kg GP BL 9 120 kg Frag SEI 227 kg	70 mm FFAR AL-18-50 Pod AL-18-70 Pod S-5 57 mm SNIA BPD 51 mm	107 mm Type 63 MRS	75 mm RCL Type 52 106 mm RCL M40 84 mm Carl Gustaf

Burundi

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
			BL 7 115 kg GP BL 9 120 kg Frag SEI 227 kg	70 mm FFAR AL-18-50 Pod AL-18-70 Pod S-5 57 mm SNIA BPD 51 mm	122 mm BM-21 'Grad' MRS	75 mm RCL Type 52 MILAN ATGW RPG-7

Cambodia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-3 'Goa' SA-7 'Grail'	AA-2 Atoll	AS-7 'Kerry' AT-2 'Swatter' AT-3 'Sagger'	FAB GP ZAB Incendiary	S-5 57 mm UB-16 57 mm Pod	107 mm Type 63 MRS 122 mm BM-21 'Grad' MRS 132 mm BM-13 MRS 140 mm BM-14 MRS	82 mm RCL B-10 106 mm RCL M40 107 mm RCL B-11 66 mm Armbrust AT-3 'Sagger' RPG-2 RPG-7

Cameroon

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
	R550 Magic	AS 12 HOT	50–250 kg GP	68 mm Matra M155 Pod 7 × 68 mm Pod	122 mm APRA MRS 122 mm BM-21 'Grad' MRS	57 mm Type 52 106 mm RCL M40A2 HOT ATGW MILAN ATGW TOW ATGW

Canada

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
ADATS Starburst	AIM-7 Sparrow AIM-9 Sidewinder AIM-120C AMRAAM	AGM-65 Maverick AGM-84 Harpoon AGM-114 Hellfire	Mk 81/82/84 GP Paveway II LGB	CRV7		66 mm LAW 84 mm Carl Gustaf 106 mm RCL M40 Eryx ATGW TOW ATGW

Cape Verde

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'						RPG-7

Central African Republic

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
						106 mm RCL M40 RPG-7

Chad

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-43 Redeye FIM-92A Stinger SA-7 'Grail'			SEI 227 kg	AL-18-50 Pod S-5 55 mm SNIA BPD 51 mm	130 mm BM-13 MRS	82 mm RCL B-10 106 mm RCL M40 Eryx ATGW Milan ATGW TOW ATGW RPG-7

Chile

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Aspic (aka Mygal) Blowpipe Crotale	AIM-9 Sidewinder Derby Python 3	AS 11 AS 12 AM 39 Exocet	3.5 kg AP APF Cardoen GP	Matra 68 mm Pod TDA 68 mm	160 mm LARS MRS	3.5 in RL M20 57 mm RCL M18 82 mm B-300

Chile — *continued*

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Javelin	Python 4	Sea Eagle	CB-130 Cluster			106 mm RCL M40
Mistral	R530		CB-250 Cluster			Armbrust
	Shafrir 2		CB-500 Cluster			M72A3
			CB-500K Cluster			Mamba ATGW
			CB-770 Cluster			MILAN ATGW
			FAMAE GP			
			Mk 81/82/83/84			
			NAPALM			
			PJ-1 (hand released)			
			WB-250F Cluster			
			WB-500F Cluster			

China

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FM-80	AA-10 'Alamo'	AS-11 'Kilter'	5 kg Type 1 Frag	57 mm Type 1 and 2	107 mm Type 63,	40 mm
FM-90	AA-11 'Archer'	AS-14 'Kedge'	100 kg Type 1 GP	90 mm Type 1	63-1, 81 MRS	RL Type 56
FN-6	AA-12 'Adder'	AS-18 'Kazoo'	100 kg Type 2 GP	122 mm HE	122 mm Type 81,	40 mm
FT-2000	AA-2 'Atoll'	AS-17 'Krypton'	250 kg AP	HF-7 90 mm Pod	84, 89, 90 MRS	RL Type 69
FT-2000a	AA-9 'Amos'	AT-2 'Swatter'	250 kg GP Type 2		130 mm Type 63,	57 mm
HN-5	PL-1	AT-3 'Sagger'	250 kg Type 1		63-1, 70 MRS	RCL Type 36
HQ-1	PL-2/PL-3	HJ-8	Incendiary		132 mm	82 mm
HQ-2	PL-5	HN-1/-2	250 kg Type 1 HEI		BM-13-16 MRS	RCL Type 65
HQ-61a	PL-7	HOT	250 kg Type 2 Cluster		140 mm	90 mm
KS-1	PL-8	HY-4	340 kg AT Cluster		BM-14-16 MRS	RL Type 51
LY-60	PL-9	TV guided ASM	500 kg LGB		180 mm	Red Arrow 8 ATGW
PL-9/9C	PL-11	YJ-1	500 kg Type 2 GP		Type 71 MRS	
QW-1	PL-12 (SD-10)	YJ-2	1500 kg Type 2 GP		252 mm	
QW-2	QW-1/-2 Vanguard	YJ-6 (C-601/	3000 kg Type 2 GP		Type 85 MRS	
RF-61A	R550 Magic	CAS-1 'Kraken')	Anti-Runway Cluster		253 mm	
SA-2 'Guideline'	SA-7 'Grail'	YJ-7 (C-701)	Anti-Tank Cluster		Type 81, 81-II MRS	
SA-7 'Grail'	TY 90	YJ-8	Durandel		273 mm	
SA-10 'Grumble'		YJ-9	FT-1/ FT-3		Type 83 MRS	
SA-15 'Gauntlet'		YJ-12	Guided Bomb		273 mm	
Type 95-2		YJ-16	Fuel/Air		WM-80 MRS	
			Explosive Cluster		284 mm	
			Kab 500Kr		Type 74 MRS	
			Kab 500L		300 mm A100,	
			Kab 1500		A120 ARS	
			Low Drag GP		305 mm	
			LS-6		Type 79 ARS	
			LT-2 LGB		320 mm	
					WS-1 ARS	
					350 mm	
					M-1B ARS	
					425 mm	
					Type 762 MRS	

Colombia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Chaparral	AIM-7 Sparrow		BK-BR	Aspid 1067		75 mm RCL M20
Sparrow	Python 3		BRP/BRPS/FAS	Hydra 70		106 mm RCL M40
	R530		Mk 81/82/83 GP	M260 Pod		TOW ATGW
	Shafrir			Mamboretta-657 Pod		

Congo-Brazzaville

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'	AA-2 'Atoll'		AO Frag	S-5 57 mm	122 mm BM-21	57 mm RCL M18
	R530		BRAB AT	UB-16 57 mm Pod	'Grad' MRS	AT-3 'Sagger'
			FAB GP		140 mm BM-14 MRS	RPG-7
			ZAB Incendiary			

Côte d'Ivoire

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
	R550 Magic		125 kg GP	68 mm		89 mm LRAC
			250 kg GP	CRV7		106 mm RCL M40
			400 kg GP	Matra Pod		
				S-5 55 mm		

Croatia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-92A Stinger	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	B-8V20A	70 mm	44 mm RB M57
SA-7 'Grail'	AA-8 'Aphid'	AT-2 'Swatter'	BetAB	80 mm Pod	'Heron' MRS	120 mm M90
SA-9 'Gaskin'		AT-3 'Sagger'	BRAB AT	S-5 57 mm	122 mm APRA MRS	MILAN
				S-8 80 mm	122 mm BM-21	
					'Grad' MRS	

Croatia — *continued*

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-10 'Grumble'		AT-6 'Spiral'	FAB GP	UB-16 57 mm Pod	122 mm LOV	AT-3 'Sagger'
SA-11 'Gadfly'		HOT	KMG-U Dispenser	UB-32 57 mm Pod	RAK 124/128 MRS	'AT-4 'Spigot'
SA-13 'Gopher'			ZAB Incendiary		122 mm M96	AT-6 'Spiral'
SA-14 'Gremlin'					Typhoon' MRS	RPG-7
SA-16 'Gimlet'					128 mm M-63	
Strijela-10					'Plamen-S' MRS	
					262 mm M-87	
					'Orkan' MRS	

Cuba

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline'	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	B-13L 122 mm Pod	122 mm BM-21	73 mm SPG-9
SA-3 'Goa'	AA-7 'Apex'	AT-2 'Swatter'	BetAB	B-8M1 80 mm Pod	'Grad' MRS	AT-3 'Sagger'
SA-6 'Gainful'	AA-8 'Aphid'	AT-3 'Sagger'	BRAB AT	B-8V20A 80 mm Pod	140 mm BM-14 MRS	RPG-7
SA-7 'Grail'	AA-10 'Alamo'	AT-6 'Spiral'	FAB GP	S-5 57 mm	FROG-4 ARS	
SA-9 'Gaskin'	AA-11 'Archer'		FAB-M54 GP	S-8 80 mm	FROG-7 ARS	
SA-13 'Gopher'	SA-7 'Grail'		FAB-M62 GP	S-13 122 mm		
SA-14 'Gremlin'			KMG-U Dispenser	UB-16 57 mm Pod		
SA-16 'Gimlet'			OFAB	UB-32 57 mm Pod		
			RBK-250/275 Cluster			
			RBK-500 Cluster			
			ZAB Incendiary			

Cyprus

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Aspide		AT-6		B-8V20A	122 mm BM-21	57 mm
Mistral		'Spiral'		80 mm Pod	'Grad' MRS	RCL M18
SA-7 'Grail'		HOT			128 mm	106 mm
SA-10 'Grumble'					M-63 MRS	RCL M40
(transferred						HOT ATGW
to Greece)						MILAN ATGW
SA-15 'Gauntlet'						RPG-7

Czech Republic

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
RBS-70	AA-2 'Atoll'	AGM-65	AO Frag	B-8M1	122 mm RM-70 MRS	82 mm RCL M59
SA-2 'Guideline'	AA-7 'Apex'	Maverick	BetAB	80 mm Pod	FROG-7 ARS	AT-3 'Sagger'
SA-3 'Goa'	AA-8 'Aphid'	AS-7 'Kerry'	BRAB AT	B-8V20A		RPG-7
SA-5 'Gammon'	AA-10 'Alamo'	AS-10 'Karen'	FAB GP	80 mm Pod		RPG-75
SA-6 'Gainful'	AA-11 'Archer'	AS-11 'Kilter'	FAB-250 ShN	LR-122 Pod		
SA-7 'Grail'	AIM-9 Sidewinder	AS-12 'Kegler'	FAB-500 ShN	LRM-122 Rocket		
SA-8 'Gecko'	SA-7 'Grail'	AS-14 'Kedge'	FAB-M54 GP	S-5 57 mm		
SA-9 'Gaskin'	SA-14 'Gremlin'	AT-2 'Swatter'	FAB-M62 GP	S-8 80 mm		
SA-13 'Gopher'		AT-3 'Sagger'	KMG-U Dispenser	S-13 122 mm		
SA-14 'Gremlin'		AT-6 'Spiral'	OFAB	UB-16 57 mm Pod		
SA-16 'Gimlet'			PROSAB-250	UB-32 57 mm Pod		
			RBK-250/275 Cluster			
			RBK-500 Cluster			
			ZAB Incendiary			

Democratic Republic of Congo

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'	R530		BL 5/6 GP	68 mm SNEB	107 mm Type 63 MRS	57 mm RCL M18
	R550 Magic		BL 8/18 Frag	Matra Pods	122 mm BM-21	75 mm RCL M20
			FAB GP	S-5 55 mm	'Grad' MRS	89 mm LRAC
			SEI Low Drag			106 mm RCL M40
						Entac ATGW
						RPG-7

Denmark

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-92A	AIM-9	AGM-65	GBU-31 JDAM	70 mm FFAR	227 mm MLRS	84 mm Carl
Stinger	Sidewinder	Maverick	Mk 7 Dispenser	CRV-7		Gustaf
I-HAWK	AIM-120	BGM-71 TOW	(Paveway II)	LAU-5002 Pod		106 mm
	AMRAAM		Mk 81/82/83/84 GP	RA 79		RCL M40
						M72 LAW
						TOW ATGW

Djibouti

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
				S-5 55 mm		106 mm
						RCL M40A1
						HOT ATGW
						RPG-7

Dominican Republic

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
			Mk 81/82 GP	Hydra 70		106 mm
			BLU-10B	LAU-59 Pod		RCL M40A1

Ecuador

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Blowpipe	Python 3	HOT	BL 5/6 GP	68 mm	122 mm	90 mm
SA-16 'Gimlet'	Python 4	MAPATS	BL 8/18 Frag	Hydra 70	RM-75 MRS	RCL M67
SA-18 'Grouse'	R530		BL 755 Cluster	Matra Type F4 Pod		106 mm
	R550 Magic					RCL M40A1
	Shafrir					

Egypt

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
AIM-120	AA-2 'Atoll'	AGM-65	AO Frag	68 mm SNEB	122 mm BM-21	107 mm
AMRAAM	AIM-7	Maverick	BAP 100	Hydra 70	'Grad' MRS	RCL B-11
(the USA	Sparrow	AGM-84	BAT 120	M260 Pod	122 mm Sakr-18	AT-3
to supply)	AIM-9	Harpoon	BRAB AT	M261 Pod	MRS	'Sagger'
Avenger	Sidewinder	AGM-114	FAB GP	S-5 57 mm	122 mm Sakr-36	HOT ATGW
Chaparral	FIM-92	Hellfire	Kader	TDA 68 mm	MRS	MILAN
Crotale	Stinger	AM 39 Exocet	KMG-U	Pod	227 mm MLRS	ATGW
FIM-92A Stinger/	PL-5	Armat	Dispenser	UB-16 57 mm	FROG-7 ARS	RPG-7V
-92C RMP	PL-7	AS-7 'Kerry'	Mk 7 Dispenser	Pod		Swingfire
I-HAWK	R530D	AS 30L	(Rockeye)			ATGW
SA-2 'Guideline'	R550 Magic	HOT	Mk 81/82/84 GP			TOW
SA-3 'Goa'	SA-7 'Grail'		ZAB Incendiary			ATGW
SA-6 'Gainful'						
SA-7 'Grail'						
SA-9 'Gaskin'						
Sakr Eye						
Sparrow						

El Salvador

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-43 Redeye			50/100 kg GP	37 mm Matra 181 Pod		75 mm RCL M20
SA-7 'Grail'			BLS GP	CRV7		90 mm RCL M67
SA-14 'Gremlin'			BL 83 Frag	Hydra 70		3.5 in RL M20

Eritrea

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'	AA-8 'Aphid'	AT-2 'Swatter'		S-5 55 mm	122 mm BM-21	73 mm SPG-9
	AA-10 'Alamo'	(unconfirmed)		S-80 80 mm	'Grad' MRS	AT-3 'Sagger'
	AA-11 'Archer'	AT-6 'Spiral'				RPG-7

Estonia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Mistral						82 mm
						B-300
						90 mm PV-
						1110 RCL
						106 mm
						M40A1 RCL
						RBS-56 'BILL'
						ATGW

Ethiopia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline'	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	B-8V20A 80 mm	122 mm BM-21	73 mm SPG-9
SA-3 'Goa'	AA-7 'Apex'	AT-2 'Swatter'	BetAB	Pod	'Grad' MRS	AT-3 'Sagger'
SA-7 'Grail'	AA-8 'Aphid'	AT-3 'Sagger'	BRAB AT	B-8M1 80 mm	200 mm BMD-20 MRS	AT-4 'Spigot'
SA-9 'Gaskin'	(unconfirmed)		FAB GP	Pod		AT-5 'Spandrel'
	AA-10 'Alamo'		ZAB Incendiary	S-5 57 mm		TOW ATGW
	SA-7 'Grail'			S-8 80 mm		
				S-24 240 mm		
				UB-16-57 57 mm Pod		
				UB-32-57 57 mm Pod		

Finland

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
ASRAD-R	AIM-4 Falcon	AS-7 'Kerry'	AO Frag	S-5 57 mm	122 mm BM-21	66 mm
Crotale	AIM-9J/L	AT-3 'Sagger'	BRAB AT	S-24 240 mm	'Grad' MRS	LAW M72
SA-3 'Goa'	Sidewinder		FAB GP	UB-16-57	122 mm	73 mm SPG-9
SA-7 'Grail'	AA-2 'Atoll'		Swedish	57 mm Pod	RM-70 MRS	Apilas
(SAM-78)	AIM-26 Falcon		Low Drag	UB-32-57		AT-3 'Sagger'
SA-11 'Gadfly'	AIM-120		ZAB Incendiary	57 mm Pod		AT-4 'Spigot'
SA-14 'Gremlin'	AMRAAM					AT-5 'Spandrel'
SA-16 'Gimlet'						EuroSpike ATGW
SA-18 'Grouse'						SS-11 ATGW
						TOW 2 ATGW

France

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Crotale	AIM-9	AM 39 Exocet	125 kg TLS	68 mm SNEB	227 mm MLRS	Apilas
FIM-92A Stinger	Sidewinder	Apache	125 kg TMX	CEM-1 Pod		AT4 CS
I-HAWK	MICA IR/EM	Armat	125 kg 81 AF	Multi-Dart 100 mm		Eryx ATGW
Mistral	Mistral ATAM	AS 15TT	125 kg Close Support	Multi-Dart 68 mm		HOT ATGW
Roland 2	R530 D and	AS 30	250 kg TLS	TDA 100 mm		MILAN ATGW
	Super 530 D/F	AS 30L	250 kg TMX	Type 100 Pods		
	R550 Magic 1	AS 37 Martel	Alkan 500/530/5030/	Type 155 Pods		
	R550 Magic 2	ASMP	5050 Dispensers	Type 68 Pods		
		HOT	AASM	Type F1/F2/F4 Pods		
		Scalp EG	BANG (CBEM-S)			
			BAP 100			
			BAT 120			
			BL 5 GP			
			BL 6 GP			
			BL 7 GP			
			BL 8 Frag			
			BL 9 Frag			
			BL 18 Frag			
			BL 21C GP			
			BL 25			
			BL 61 Frag			
			BL 70 Frag			
			BL 83			
			BL 99 Incendiary			
			BL 104			
			BL 105			
			BL 106			
			BLU 104			
			BLU 105			
			BLU-109/B			
			BL EU2 GP			
			BL EU2FR Frag			
			BL EU2P Penetration			
			BL EU3 GP			
			BL EU4 GP			
			BLG 66 Belouga			
			BM 400			
			CASCAD Mk1			
			CEM-1 Pod			
			Durandal			
			I-500 Penetration			
			LGB			
			LU 250 EG-FT			
			LXT 462 Practice			
			Mk 81 GP			
			Mk 82 GP			
			Mk 83 GP			
			Mk 84 GP			
			Paveway II/III LGB			
			Rockeye 2 Mk 20			
			SFA Retard System			
			Type 10 RND			
			Type 200 Retard System			
			Type 200 GP			

Gabon

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Aspic	R530	AS 11	BL 5/6 GP	37 mm	107 mm MRS	106 mm RCL
(aka Mygal)	R550 Magic	AS 12	BL 8/18 Frag	68 mm	122 mm RM-70 MRS	M40
Mistral		HOT	BL 83 (T15) Frag	Matra 181 Pod	140 mm Teruel MRS	MILAN ATGW
			BLU-10B	TDA 68 mm Pod		
			Mk 81 GP			
			Type 25 GP			

Georgia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Python 5	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	B-8M1 80 mm Pod	122 mm BM-21	73 mm SPG-9
SA-2 'Guideline'	AA-7 'Apex'	AS-10 'Karen'	BRAB AT	B-8V20A	'Grad' MRS	AT-3 'Sagger'
SA-3 'Goa'	AA-8 'Aphid'	AS-11 'Kilter'	FAB GP	80 mm Pod	122 mm RM-70	AT-4 'Spigot'
SA-5 'Gammon'	SA-7 'Grail'	AS-14 'Kedge'	FAB-M54 GP	B-13L	MRS	AT-5 'Spandrel'
SA-7 'Grail'	SA-14 'Gremlin'	AT-2 'Swatter'	FAB-M62 GP	122 mm Pod	160 mm	RPG-7
SA-8 'Gecko'		AT-3 'Sagger'	KhaB Chemical	S-5 57 mm	LAR-160 MRS	RPG-18
SA-9 'Gaskin'		AT-6 'Spiral'	KMG-U Dispenser	S-8 80 mm	262 mm	
(unconfirmed)			RBK-500 Cluster	S-13 122 mm	M-87 'Orkan'	
SA-11 'Gadfly'			ZAB Incendiary	S-16 160 mm	MRS	
SA-14 'Gremlin'				S-21 220 mm	M-63 MRS	
SA-16 'Gimlet'				S-24 240 mm		
				UB-16 57 mm Pod		
				UB-32 57 mm Pod		

Germany

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
ASRAD	AIM-9	AGM-65	BAP 100	68 mm SNEB	227 mm MLRS	HOT ATGW
FIM-92A/C	Sidewinder	Maverick	BAT 120	B-8M1 80 mm Pod		MILAN ATGW
Stinger	AIM-120	AGM-88A	BL 755 Cluster	B-13L 122 mm Pod		Panzerfaust 3
I-HAWK	AMRAAM	HARM	BLG 66 Belouga	M-100 137 mm		TOW ATGW
Patriot	AA-10 'Alamo'	BGM-71 TOW	BLU-109/B	Multi-Dart 100 mm		
Roland 2	AA-11 'Archer'	HOT	(GBU-24A)	Multi-Dart 68 mm		
SA-16 'Gimlet'	IRIS-T	Kormoran 1/2	Durandal	Type M155 Pod		
(may be used		PARIS-3-LR	Mk 81/82/84 GP			
for training)		Sea Skua	MW-1 Cluster			
SA-18 'Grouse'			system			
(may be used			ZAB Incendiary			
for training)						

Ghana

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'	R550 Magic		SEI Low Drag	SNIA BPD 51 mm		84 mm Carl
						Gustaf
						RPG-7

Greece

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
ASRAD	AIM-4 Falcon	AFDS	BAP 100	68 mm SNEB	122 mm	90 mm RCL M67
Crotale NG	AIM-7 Sparrow	AGM-12	BAT 120	Hydra 70	RM-70/85 MRS	106 mm RCL M40
FIM-43 Redeye	AIM-9	Bullpup	BLG 66 Belouga	M260 Pod	227 mm MLRS	TOW ATGW
FIM-92A/C	Sidewinder	AGM-45	CBU-58	M261 Pod		MILAN ATGW
Stinger	AIM-120 AMRAAM	Shrike	CBU-71	Matra Pods		Wasp
I-HAWK	MICA IR/EM	AGM-65 Maverick	Durandal	MRL 70		
Nike-Hercules	R530D	AGM-88 HARM	GBU-8	Multi-Dart 68 mm		
Patriot	R550 Magic II	AGM-114	Mk 20 Dispenser	Multi-Dart 100 mm		
SA-8 'Gecko'		Hellfire	(Rockeye)	TDA Pods		
SA-10c 'Grumble'		AGM-119	Mk 81/82/83/84 GP			
SA-15 'Gauntlet'		Penguin 2	Paveway II/III LGB			
Sparrow		AM 39 Exocet				
		AS 12				
		SCALP EG				

Guatemala

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
			BL-5 GP	37 mm		3.5 in RL M20
			BL-83 Frag	Hydra 70		106 mm RCL M40
			BLU-10B	LAU-59 Pod		
			Mk 81/82 GP	Matra 181 Pod		

Guinea

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	S-5 57 mm	220 mm BM	82 mm RCL B-10
			FAB GP	S-24 240 mm	9P140 'Uragan' MRS	AT-3 'Sagger'
			ZAB Incendiary	UB-16 57 mm Pod		RPG-7

GuineaBissau

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'	AA-2 'Atoll'		AO Frag	S-5 57 mm	220 mm BM	3.5 in RL M20
			FAB GP	S-24 240 mm	9P140 MRS	75 mm RCL
			ZAB Incendiary	UB-16 57 mm Pod		Type 52
						82 mm RCL B-10
						AT-3 'Sagger'
						RPG-7

Guyana

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'						RPG-7

Haiti

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
			BL-7 115 kg GP	SNIA BPD 51 mm		57 mm RCL M18
			BL-9 120 kg Frag	AL-18-50 Pod		106 mm RCL M40
			SEI 227 kg			

Honduras

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
	AIM-9		BLU-10B	CASA Pods		84 mm Carl
	Sidewinder		BR-125	Hydra 70		Gustaf
	Shafrir		BR-250	INTA 59		106 mm RCL M40
			Mk 81/82 GP	INTA 511		
				LAU-59 Pod		

Hungary

SAM
Mistral
SA-2 'Guideline'
SA-3 'Goa'
SA-4 'Ganef'
SA-5 'Gammon'
SA-6 'Gainful'
SA-7 'Grail'
SA-9 'Gaskin'
SA-13 'Gopher'
SA-14 'Gremlin'
SA-16 'Gimlet'
SA-18 'Grouse'

AAM
AA-2 'Atoll'
AA-6 'Acrid'
AA-8 'Aphid'
AA-10 'Alamo'
AA-11 'Archer'
AIM-9 Sidewinder
AIM-120
SA-7 'Grail'

ASM
AS-7 'Kerry'
AS-10 'Karen'
AS-12 'Kegler'
AT-2 'Swatter'
AT-3 'Sagger'
AT-6 'Spiral'

Bombs
AO Frag
BetAB
BRAB AT
FAB GP
FAB-M54 GP
FAB-M62 GP
KMG-U Dispenser
OFAB
Paveway II
RBK-250/275 Cluster
RBK-500 Cluster
ZAB Incendiary

Rockets – air
B-8M1
80 mm Pod
B-8V20A
80 mm Pod
B-13L 122 mm Pod
M-100 137 mm
S-5 57 mm
S-8 80 mm
S-13 122 mm
S-24 240 mm
UB-16 57 mm Pod
UB-32 57 mm Pod

Rockets – ground
122 mm BM-21
'Grad' MRS
FROG-7 ARS

Anti-tank
73 mm SPG-9
107 mm RCL B-11
AT-3 'Sagger'
AT-4 'Spigot'
RPG-7

India

SAM
SA-2 'Guideline'
SA-3 'Goa'
SA-5 'Gammon'
SA-6 'Gainful'
SA-7 'Grail'
SA-8 'Gecko'
SA-9 'Gaskin'
SA-10c 'Grumble'
SA-11 'Gadfly'
SA-13 'Gopher'
SA-14 'Gremlin'
SA-15 'Gauntlet'
SA-16 'Gimlet'
SA-18 'Grouse'
SA-19 'Grison'

AAM
AA-2 'Atoll'
AA-7 'Apex'
AA-8 'Aphid'
AA-10 'Alamo'
AA-11 'Archer'
AA-12 'Adder'
Astra (unconfirmed)
Python 4 (unconfirmed)
R530
R550 Magic II

ASM
AM 39 Exocet
AS-7 'Kerry'
AS-17 'Krypton'
AS 30L
AT-2 'Swatter'
AT-3 'Sagger'
AT-6 'Spiral'
Sea Eagle

Bombs
1,000 lb GP
AO Frag
Beluga CBU
BetAB
BL 755
BRAB AT
FAB GP
FAB-M54 GP
FAB-M62 GP
Griffin LGB System
HADES
KMG-U Dispenser
Matra LGB
OFAB
RBK-250/275 Cluster
RBK-500 Cluster
ZAB Incendiary

Rockets – air
68 mm SNEB
B-8M1 80 mm Pod
B-8V20A 80 mm Pod
S-5 57 mm
S-8 80 mm
S-24 240 mm
TDA 68 mm Pod
UB-16 57 mm Pod
UB-32 57 mm Pod

Rockets – ground
122 mm BM-21
'Grad' MRS
122 mm LRAR MRS
214 mm 'Pinacha' MRS
300 mm BM 9A52
'Smerch' MRS

Anti-tank
73 mm SPG-9
84 mm Carl Gustaf
106 mm RCL M40
AT-3 'Sagger'
AT-4 'Spigot'
Flame ATGW
MILAN ATGW

Indonesia

SAM
Kobra
Mistral
Rapier
RBS-70

AAM
AA-10 'Alamo'
AA-11 'Archer'
AIM-9
Sidewinder

ASM
AGM-65 Maverick
AM 39 Exocet
HOT

Bombs
Mk 7 Dispenser (Rockeye)
Mk 81/82 GP

Rockets – air
CRV7
FFAR 2.75 in
Hydra 70
LAU-61 Pod
LAU-68 Pod

Rockets – ground
70 mm NDL-40 MRS
122 mm RM-70 MRS

Anti-tank
3.5 in RL M20
84 mm Carl Gustaf
89 mm LRAC-89
106 mm RCL M40
Entac ATGW

Iran

SAM
Crotale
FIM-92A Stinger
FM-80
FM-90
HAWK
HN-5A
HQ-2
Misagh-1/-2
Pantsyr-S1
Rapier
SA-5 'Gammon'
SA-6 'Gainful'
SA-7 'Grail'
SA-10c/d 'Grumble'
SA-14 'Gremlin'
SA-15 'Gauntlet'
Tigercat

AAM
AA-8 'Aphid'
AA-9 'Amos'
AA-10 'Alamo'
AA-11 'Apex'
AIM-54A Phoenix
AIM-7 Sparrow
AIM-9 Sidewinder
MIM-23 HAWK Variant
PL-2
PL-5
PL-7
PL-9

ASM
AGM-65 Maverick
AGM-84 Harpoon
AS-4 'Kitchen'
AS-6 'Kingfish'
AS-10 'Karen'
AS-11 'Kilter'
AS-12 'Kegler'
AS-14 'Kedge'
AS-16 'Kickback'
AT-3 'Sagger'
BGM-71 TOW
FL-6
I-RAAD
RIM-66 (modified)
Sattar-1/ 2
YJ-1 (C-801)
YJ-2 (C-802)
YJ-7 (C-701/ CAS-1 'Kraken')
Zoobin

Bombs
AO Frag
BetAB
BL 755 CBU
Chemical Spray Tanks
FAB GP
FAB-250 ShN
FAB-500 ShN
FAB-M54
FAB-M62
KhAB Chemical
KMG-U Dispenser
Mk 81/82/84 GP
OFAB
PROSAB-250 Cluster
Qadr PGM
ZAB Incendiary

Rockets – air
Arash 122 mm
B-13L 122 mm Pod
Hydra 70
LAU-130/A Pod
LAU-131/A Pod
Nader 40 mm
Noor 122 mm
Oghab 230 mm
S-13 122 mm
Shahin 1/2

Rockets – ground
107 mm Fadjr-1 (Type 63) MRS
122 mm Arash ARS
122 mm BM-11 MRS
122 mm BM-21 'Grad' MRS
122 mm Fadjr-6 ARS
122 mm Hadid ARS
122 mm Noor ARS
122 mm Type 81 MRS
230 mm Oghab ARS
240 mm Fadjr-3 ARS
240 mm 'Falaq-1' MRS
240 mm M1985 MRS
333 mm 'Falaq-2' MRS
333 mm Fadjr-5 ARS
333 mm Shahin 1 ARS
333 mm Shahin 2 ARS
355.6 mm Nazeat ARS
610 mm Zelzal ARS
Haseb ARS

Anti-tank
40 mm NAFEZ
73 mm PG-9
AT-3 'Sagger'
Dragon ATGW
Entac ATGW
RPG-7
TOW ATGW
Shahin ATGW

Iraq

SAM
HN-5A
Roland 2
SA-2 'Guideline'
SA-3 'Goa'
SA-6 'Gainful'
SA-7 'Grail'
SA-8 'Gecko'
SA-9 'Gaskin'
SA-13 'Gopher'
SA-14 'Gremlin'
SA-16 'Gimlet'

AAM
AA-2 'Atoll'
AA-6 'Acrid'
AA-7 'Apex'
AA-8 'Aphid'
AA-10 'Alamo'
PL-2
PL-5
R530
R550 Magic

ASM
AM 39 Exocet
ARMAT
AS 11
AS 12
AS 15TT
AS 30
AS-4 'Kitchen'
AS-6 'Kingfish'
AS-9 'Kyle'
AS-14 'Kedge'
AT-3 'Sagger'
HOT

Bombs
BADR-28 GP
CB-470 CBU
Chemical Spray Tanks
FARIS-250 GP
KAAKAA-100 Incendiary
KAAKAA-120 AP
KAAKAA-250 AP
KAAKAA-250 Incendiary
KAAKAA-500 AP
KAAKAA-500 GP

Rockets – air
B-13L 122 mm Pod
B-8M1 80 mm Pod
B-8V20A 80 mm Pod
S-5 57 mm
S-8 80 mm
S-13 122 mm
S-24 240 mm
UB-16 57 mm Pod
UB-32 57 mm Pod

Rockets – ground
107 mm Type 63 MRS
108 mm FGT 108R MRS
122 mm BM-11 MRS
122 mm BM-21 'Grad' MRS
122 mm M1975 MRS
122 mm Scania MRS
127 mm Sajeel 30 MRS
132 mm BM-13 MRS
140 mm MRS
180 mm Sajeel 40 MRS
262 mm Ababeel MRS
300 mm Sajeel 60 MRS

Anti-tank
73 mm SPG-9
AT-3 'Sagger'
AT-4 'Spigot'
HOT ATGW
MILAN ATGW
RPG-7

Iraq — *continued*

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
		YJ-6 (C-601/ CAS-1 'Kraken')	KhAB Chemical NAAMAN-250 CBU NAAMAN-500 CBU NASR-7 GP NASR-28 GP NASR-250 Low Drag GP NASR-400 Low Drag GP NASR-500P Penetration NASR-1000P Penetration		400 mm Ababeel 100 MRS FROG-7 ARS Laith 90 ARS	

Ireland

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
RBS-70				LAU-7A mm pods SNEB 68 mm		84 mm Carl Gustaf Javelin ATGW MILAN ATGW

Israel

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Arrow-2 Chaparral FIM-43 Redeye FIM-92A/C Stinger I-HAWK Patriot Spyder	AIM-120 AMRAAM AIM-7 Sparrow AIM-9 Sidewinder Derby Python 3 Python 4 Python 5 Shafrir II	AGM-114 Hellfire AGM-142 Popeye I/II AGM-45 Shrike AGM-65 Maverick AGM-78 Standard AGM-84 Harpoon AGM-88 HARM BGM-71 TOW Delilah (STAR-1) Gabriel 2/3/4 ITALD MAPATS Nimrod Spike-ER (NT-D/Dandy) Spike-LR (NT-S)	ATAP-300 Cluster ATAP-500 Cluster Barad Condib 70/120 GBU-15 Glide Griffin LGB Guillotine LGB IDBU-33 Lizard LGBs Mk 81/82/83 GP Opher PGM PB-500 AI Pyramid RAM CBU SPICE PGB TAL 1 and 2 Cluster	CRV7 Hydra 70 M197 M620 Pod M621 Pod	122 mm BM-21 'Grad' MRS 227 mm MLRS 240 mm BM-24 MRS 290 mm MAR ARS 360 mm MAR ARS	84 mm Carl Gustaf 106 mm RCL M40 AT-3 'Sagger' Dragon ATGW Gill, Spike ATGW MAPATS ATGW TOW ATGW

Italy

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Aspide Mk1 Aspide 2000 FIM-92A/C Stinger HAWK Mistral Nike-Hercules SAMP-T Spada	AIM-7 Sparrow AIM-9 Sidewinder AIM-120 AMRAAM Aspide 1A FIM-92 Stinger	AGM-65 Maverick AGM-88 HARM AS 12 AS 20 BGM-71 TOW Kormoran Marte Mk 1 Marte Mk 2 Storm Shadow	MW-1 Mk 7 Dispenser (Rockeye) BA 102 BA 103 BA 104 BL 755 Cluster Opher	Aerea BRD-4 Pods Aerea Helicopter DC Kit Aerea Multi-Task-Pod AL-6/18/25 Pods HL-7/12/19 Pods HL-14/18/28 Pods SAL-4/6/12 Pods SNIA BPD 51 mm SNIA BPD 81 mm Medusa SNIA BPD 122 mm Falco	227 mm MLRS	80 mm Folgore 106 mm RCL M40 Apilas MILAN ATGW TOW ATGW

Japan

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-92A Stinger I-HAWK Patriot Type 81 Tan-SAM Type 91 Kin-SAM Type 93 Kin-SAM	AAM-3 AAM-4 AAM-5 AIM-7 Sparrow AIM-9 Sidewinder AIM-120 AMRAAM	AGM-84 Harpoon ASM-1 ASM-2 ASM-3 AGM-114 Hellfire BGM-71 TOW	Mk 7 Dispenser Mk 81/82/83 GP Paveway II GCS1 (Model 1, Model 2)	CRV7 Hydra 70 M260 Pod M261 Pod	130 mm Type 75 MRL 227 mm MLRS	84 mm Carl Gustaf 106 mm RCL M40 KAM-3D ATGW TOW ATGW Type 64/79/87 ATGW

Jordan

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-43 Redeye I-HAWK Mistral Pantsyr-S1 SA-7 'Grail' SA-8 'Gecko' SA-13 'Gopher' SA-14 'Gremlin' SA-18 'Grouse'	AIM-7 Sparrow AIM-9 Sidewinder R530 R550 Magic	AGM-65 Maverick BGM-71 TOW	ALD Frag BIN Napalm BR Low Drag Mk 81/82/83 GP	68 mm SNEB CASA Type 18.037 Pod Hydra 70 INTA S9 M260 Pod M261 Pod		106 mm RCL M40 Apilas Dragon ATGW HOT ATGW LAW-80 RPG-7 TOW ATGW

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Kazakhstan

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline'	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	B-8M1 80 mm Pod	122 mm BM-21	73 mm SPG-9
SA-3 'Goa'	AA-7 'Apex'	AS-9 'Kyle'	BetAB	B-8V20A 80 mm Pod	'Grad' MRS	AT-3 'Sagger'
SA-5 'Gammon'	AA-8 'Aphid'	AS-10 'Karen'	BRAB AT	B-13L 122 mm Pod	220 mm BM	AT-4 'Spigot'
SA-7 'Grail'	AA-9 'Amos'	AS-11 'Kilter'	FAB GP	M-100 137 mm	9P140 MRS	AT-5 'Spandrel'
SA-10 'Grumble'	AA-10 'Alamo'	AS-12 'Kegler'	FAB-M54 GP	S-5 57 mm		AT-6 'Spiral'
SA-14 'Gremlin'	AA-11 'Archer'	AS-13 'Kingbolt'	FAB-M62 GP	S-8 80 mm		RPG-7
SA-16 'Gimlet'		AS-14 'Kedge'	OFAB	S-13 122 mm		RPG-18
		AS-17 'Krypton'	ZAB Incendiary	S-24 240 mm		
		AT-6 'Spiral'		UB-16 57 mm Pod		
				UB-32 57 mm Pod		

Kenya

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Mistral	AIM-9	AGM-65 Maverick	227 kg GP Mk 1/2	68 mm SNEB		84 mm Carl
	Sidewinder	BGM-71 TOW	AV-BAFG-120	FZ-70 mm		Gustaf
			AV-BI 200	LAU-32 Pod		MILAN ATGW
			BL-61 125 kg	Matra F4 Pod		Swingfire ATGW
			Type 25 250 kg	SBAT 37 mm		

Korea, North

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
HN-5A	AA-2 'Atoll'	AS-7 'Kerry'	5 kg Type 1 Frag	57 mm Type 1 and 2	107 mm Type 63	82 mm SPG-82
SA-2 'Guideline'	AA-8 'Aphid'	AS-10 'Karen'	100 kg Type 1 GP	90 mm Type 1	MRS	82 mm RCL B-10
(some may be	AA-10 'Alamo'	AS-11 'Kilter'	100 kg Type 2 GP	B-8M1 80 mm Pod	122 mm BM-11	107 mm RCL B-11
Chinese HQ-2	AA-11 'Archer'	AT-2 'Swatter'	250 kg GP Type 2	B-8V20A 80 mm Pod	MRS	AT-3 'Sagger'
systems)	SA-7 'Grail'	AT-3 'Sagger'	250 kg Type 1 HE	B-131 122 mm Pod	122 mm BM-21	RPG-2
SA-3 'Goa'	PL-2/3	AT-6 'Spiral'	Incendiary	HF-16B 57 mm Pod	'Grad' MRS	RPG-7V
SA-5 'Gammon'	PL-5	C-801	250 kg Type 1	HF-7 90 mm Pod	122 mm M1977 MRS	
SA-6 'Gainful'	PL-7		Incendiary	S-5 57 mm	122 mm M1985 MRS	
SA-7 'Grail'			Anti-Runway	S-8 80 mm	130 mm Type 63 MRS	
SA-13 'Gopher'			Cluster	S-13 122 mm	140 mm RPU-14-16	
SA-14 Gremlin'			Anti-Tank Cluster	S-21 220 mm	MRS	
SA-16 'Gimlet'			AO Frag	S-24 240 mm	200 mm BMD-20 MRS	
			BetAB	UB-16 57 mm Pod	240 mm BM-24 MRS	
			BRAB AT	UB-32 57 mm Pod	240 mm M1991 MRS	
			FAB GP		FROG-5 ARS	
			FAB-M54 GP		FROG-7 ARS	
			FAB-M62 GP			
			Fuel Air Explosive			
			Cluster			
			KMG-U Dispenser			
			Low Drag GP			
			RBK-500 Cluster			

Korea, South

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Chun Ma	AIM-7 Sparrow	AGM-12 Bullpup	Mk 81/82/84 GP	CRV7	130 mm	3.5 in RL M20
(Pegasus)	AIM-9 Sidewinder	AGM-65 Maverick	Paveway II LGB	Hydra 70	KM809A1 MRS	66 mm LAW M72
FIM-92A Stinger	AIM-120	AGM-78 Standard	Mk 7 Dispenser	LAU-130/A Pod	227 mm MLRS	106 mm RCL M40
I-HAWK	AMRAAM	AGM-84 Harpoon	(Rockeye)	LAU-131/A Pod		AT-7 'Saxhorn'
Javelin	Mistral ATAM	AGM-88 HARM		M260 Pod		TOW ATGW
KP-SAM (also		AGM-114 Hellfire		M261 Pod		
known as Singung)		AGM-130				
Mistral		AGM-142 Popeye				
Nike-Hercules		BGM-71 TOW				
Patriot		Sea Skua				
SA-16 'Gimlet'						
SA-18 'Grouse'						

Kuwait

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-92A	AIM-7 Sparrow	AGM-114	AV-BAFG	68 mm SNEB	300 mm BM 9A52	84 mm RCL
Stinger	AIM-9 Sidewinder	Hellfire	AV-BI	CRV7	'Smerch' MRS	HOT ATGW
HAWK III	R530	AGM-65	BLU Napalm	Hydra 70	FROG-7 ARS	TOW ATGW
I-HAWK	R550 Magic	Maverick	Mk 81/82/84 GP	LAU-61 Pod		
Patriot		AGM-84 Harpoon	Paveway II	LAU-68 Pod		
SA-7 'Grail'		AM 39 Exocet		Multi-Dart 100 mm		
(unconfirmed)		HOT		Multi-Dart 68 mm		
SA-8 'Gecko'				TDA Pods		
(unconfirmed)						
Sparrow						
Starburst						

Kyrgyzstan

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline'					122 mm BM-21	73 mm SPG-9
SA-3 'Goa'					'Grad' MRS	AT-3 'Sagger'
SA-7 'Grail'						AT-4 'Spigot'
SA-14 'Gremlin'						AT-5 'Spandrel'
SA-16 'Gimlet'						RPG-7

Laos

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-3 'Goa'	AA-2 'Atoll'		AO Frag	S-5 57 mm		106 mm RCL M40
SA-7 'Grail'			BetAB	S-24 240 mm		107 mm RCL B-11
SA-18 'Grouse'			BRAB AT	UB-16 57 mm Pod		AT-3 'Sagger'
			FAB GP	UB-32 57 mm Pod		RPG-7
			ZAB Incendiary			

Latvia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
RBS-70		AT-2 'Swatter'		S-5 57 mm		84 mm RCL
				UB-16 57 mm Pod		AT-3 'Sagger'
				UB-32 57 mm Pod		RPG-7

Lebanon

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'		AS 12	BL 5/6 GP	68 mm SNEB	122 mm	89 mm RL M65
SA-14 'Gremlin'		HOT	BL 8/18 Frag	68 mm Pod	BM-11 MRS	106 mm RCL M40
SA-16 'Gimlet'					122 mm BM-21 'Grad' MRS	MILAN ATGW
					FROG-7 ARS	TOW ATGW
						RPG-7

Libya

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Crotale	AA-2 'Atoll'	AS-4 'Kitchen'	AO Frag	68 mm SNEB	107 mm	73 mm SPG-9
SA-2 'Guideline'	AA-6 'Acrid'	AS-7 'Kerry'	BAP 100	B-8M1	Type 63 MRS	84 mm Carl Gustaf
SA-3 'Goa'	AA-7 'Apex'	AS-9 'Kyle'	BAT 120	80 mm Pod	122 mm	106 mm RCL M40
SA-5 'Gammon'	AA-8 'Aphid'	AT-2 'Swatter'	BetAB	B-8V20A	BM-11 MRS	107 mm RCL B-11
SA-6 'Gainful'	R530	AT-3 'Sagger'	BRAB AT	80 mm Pod	122 mm BM-21 'Grad' MRS	AT-3 'Sagger'
SA-7 'Grail'	R550 Magic	AT-6 'Spiral'	Durandal	B-13L	122 mm	AT-4 'Spigot'
SA-8 'Gecko'	SA-7 'Grail'		FAB GP	122 mm Pod	RM-70 MRS	RPG-7
SA-9 'Gaskin'			FAB-M54 GP	S-5 57 mm	130 mm	TOW ATGW
SA-13 'Gopher'			FAB-M62 GP	S-8 80 mm	M51 MRS	
			KhaB Chemical	S-13 122 mm	FROG-7 ARS	
			KMG-U Dispenser	S-16 160 mm		
			RBK-500 Cluster	S-21 220 mm		
			ZAB Incendiary	S-24 240 mm		
				TDA 100 mm		
				UB-16 57 mm Pod		
				UB-32 57 mm Pod		

Lithuania

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-92 Stinger	AA-2 'Atoll'	AT-2 'Swatter'	FAB GP	S-5 57 mm		84 mm RCL
RBS-70				UB-16 57 mm Pod		RPG-2
SA-7 'Grail'				UB-32 57 mm Pod		RPG-7

Luxembourg

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
						66 mm LAW M72
						106 mm RCL M40
						TOW ATGW

Macedonia, Former Yugoslav Republic of

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-92 Stinger		AT-2 'Swatter'	FAB GP	S-5 57 mm	122 mm M-63 MRS	44 mm M80
SA-7 'Grail'				S-80 80 mm	122 mm BM-21 MRS	44 mm RB M57
SA-13 'Gopher'				UB-16 57 mm Pod		64 mm RBR M80
SA-16 'Gimlet'						82 mm M60A RCL
						90 mm M79
						AT-3 'Sagger'
						MILAN ATGW
						RPG-7

Madagascar

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	S-5 57 mm		106 mm RCL M40
			BetAB	S-24 240 mm		RPG-7
			BRAB AT	UB-16 57 mm Pod		
			FAB GP	UB-32 57 mm Pod		
			ZAB Incendiary			

Malawi

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Blowpipe						3.5 in RL M20

Malaysia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Anza Mk II	AA-8 'Aphid'	AGM-45 Shrike	FAB GP	Hydra 70	ASTROS II MRS	84 mm Carl Gustaf
Javelin	AA-10 'Alamo'	AGM-65 Maverick	Mk 81/82/84 GP	LAU-61 Pod		106 mm RCL M40
Rapier	AA-11 'Archer'	AGM-84 Harpoon	SEI Low Drag	LAU-68 Pod		AT-13 Metis-M
SA-18 'Grouse'	AA-12 'Adder'	AS-14 'Kedge'		MRL 70		Baktar Shikan (Red Arrow 8)
Starburst	AIM-7 Sparrow			Multi-Dart 68 mm		C-90CR
	AIM-9 Sidewinder			Multi-Dart 100 mm		Eryx
				TDA Pods		SS-11 ATGW

Mali

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-3 'Goa'	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	S-5 57 mm	122 mm BM-21 'Grad' MRS	AT-3 'Sagger'
SA-7 'Grail'			BetAB	S-24 240 mm		RPG-2
			BRAB AT	UB-16 57 mm Pod		RPG-7
			FAB GP	UB-32 57 mm Pod		
			ZAB Incendiary			

Mauritania

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'						57 mm RCL M18
SA-9 'Gaskin'						75 mm RCL M20
						106 mm RCL M40
						MILAN ATGW
						RPG-7

Mauritius

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'						

Mexico

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
RBS 70	AIM-9 Sidewinder	AGM-65 Maverick	Mk 81/82 GP	CRV7	FIROS 6 MRS	106 mm RCL M40
SA-18 'Grouse'				Hydra 70		MILAN ATGW
				LAU-5002 Pod		
				S-5 57 mm		
				UB-16 57 mm Pod		

Moldova

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-3 'Goa'	AA-8 'Aphid'	AS-7 'Kerry'	AO Frag	B-8M1 80 mm Pod	220 mm BM 9P140	73 mm SPG-9
SA-5 'Gammon'	AA-10 'Alamo'	AT-2 'Swatter'	BetAB	M-100 137 mm	'Uragan' MRS	AT-4 'Spigot'
SA-7 'Grail'	AA-11 'Archer'		BRAB AT	S-5 57 mm		RPG-7
SA-14 'Gremlin'			FAB GP	S-8 80 mm		RPG-18
SA-16 'Gimlet'			FAB-M54 GP	S-24 240 mm		
			ZAB Incendiary	UB-32 57 mm Pod		

Mongolia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	B-8V20A 80 mm Pod	122 mm BM-21	73 mm SPG-9
	SA-7 'Grail'	AT-2 'Swatter'	BetAB	S-5 57 mm	'Grad' MRS	AT-3 'Sagger'
		AT-3 'Sagger'	BRAB AT	S-8 80 mm		RPG-7
			FAB GP	S-24 240 mm		
			FAB-M54 GP	UB-32 57 mm Pod		
			KMG-U Dispenser			
			ZAB Incendiary			

Morocco

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Chaparral	AIM-9	AGM-65 Maverick	Mk 81/82/84 GP	68 mm SNEB	122 mm BM-21	3.5 in RL M20
SA-7 'Grail'	Sidewinder	HOT	BL 5/6 GP	TDA 68 mm Pod	'Grad' MRS	106 mm RCL M40
	R530		BL 8/18 Frag	TDA 100 mm		66 mm M72 LAW
	R550 Magic 1					66 mm M72 LAW
						Dragon ATGW
						HOT ATGW
						MILAN ATGW
						RPG-7V
						TOW ATGW

Mozambique

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline' (unconfirmed)	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	B-8V20A 80 mm Pod	122 mm BM-21	73 mm SPG-9
SA-3 'Goa'	SA-7 'Grail'	AT-2 'Swatter'	BetAB	S-5 57 mm	'Grad' MRS	82 mm RCL B-10
SA-7 'Grail'		AT-3 'Sagger'	BRAB AT	S-8 80 mm		107 mm RCL B-12
SA-9 'Gaskin'			FAB GP	S-24 240 mm		AT-3 'Sagger'
			ZAB Incendiary	UB-32 57 mm Pod		AT-4 'Spigot'

Myanmar

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Bloodhound Mk II	AA-8 'Aphid'	AT-3 'Sagger'	100 kg Type 1 GP	12 Tube 80 mm Pod	107 mm	106 mm
(some reports)	AA-10 'Alamo'	AT-6 'Spiral'	100 kg Type 2 GP	57 mm Type 1 and 2	Type 63 MRS	M40A1 RCL
HN-5A	AA-11 'Archer'		250 kg GP Type 2	90 mm Type 1		
SA-16 'Gimlet'	PL-2/PL-3		250 kg Type 1	HF-16B 57 mm Pod		
(some reports)	PL-5		Incendiary	HF-7 90 mm Pod		
SA-18 'Grouse'	SA-7 'Grail'		250 kg Type 1	S-8 80 mm		
			HE Incendiary			
			FAB GP			
			Low Drag GP			

Namibia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'					122 mm BM-21 'Grad' MRS	RPG-7

Netherlands

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-92A/C	AIM-9	AGM-65	BL-755	CRV7	227 mm MLRS	66 mm M72 LAW
Stinger	Sidewinder	Maverick	CBU-87	Hydra 70		84 mm
I-HAWK	AIM-120B	AGM-114 Hellfire	GBU-31 JDAM	LAU-130/A Pod		Carl Gustaf
NASAMS	AMRAAM		Mk 81/82/84 GP	LAU-131/A Pod		Bofors AT-4
(on order)			Paveway II LGB			Dragon ATGW
Patriot						TOW ATGW

New Zealand

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Mistral	AIM-9 Sidewinder	AGM-12 Bullpup	Mk 81/82/84 GP	Hydra 70		66 mm M72 LAW
		AGM-65 Maverick	SEI Low Drag	LAU-61 Pod		84 mm Carl Gustaf
		AGM-84 Harpoon		LAU-68 Pod		106 mm RCL M40
		AGM-119 Penguin		CRV7		

Note: some of these systems may be non-operational.

Nicaragua

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'		AT-2 'Swatter'		B-8V20A 80 mm Pod	122 mm BM-21	AT-3 'Sagger'
SA-9 'Gaskin'		AT-3 'Sagger'		S-5 57 mm	'Grad' MRS	RPG-7
SA-14 'Gremlin'				S-8 80 mm		
SA-16 'Gimlet'				UB-16 57 mm Pod		
				UB-32 57 mm Pod		

Niger

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
						57 mm RCL M18
						75 mm RCL M20
						89 mm LRAC

Nigeria

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Blowpipe	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	68 mm SNEB	122 mm	3.5 in RL M20
Roland 2	R550 Magic	AS 30L	BetAB	Matra M155 Pod	APR 40 MRS	84 mm
SA-7 'Grail'		AT-6	BL 5/6 GP	S-5 57 mm	122 mm BM-21	Carl Gustaf
		'Spiral'	BL 8/18 Frag	S-24 240 mm	'Grad' MRS	89 mm LRAC
		HOT	BRAB AT	UB-16 57 mm Pod		RPG-7
			FAB GP	UB-32 57 mm Pod		Swingfire ATGW
			ZAB Incendiary			

Norway

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
I-HAWK NOAH	AIM-9	AGM-119	Mk 81/82/84 GP	CRV7	227 mm MLRS	66 mm M72 LAW
NASAMS (replacing	Sidewinder	Penguin 3	BL 755	Hydra 70		84 mm Carl
I-HAWK NOAH	AIM-120B		Paveway II	LAU-130/A Pod		Gustaf
RBS-70	AMRAAM			LAU-131/A Pod		106 mm RCL M40
	IRIS-T			RA 79		Eryx ATGW
						TOW ATGW

Oman

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Blowpipe	AIM-9	AM 39 Exocet	125 kg 81AF	68 mm SNEB	122 mm	LAW 90 RL
Javelin	Sidewinder	AS 30L	227 kg GP Mk 1/2	CRV7	Type 90 MRS	MILAN ATGW
Mistral	AIM-120		454 kg GP	Matra Type F4 Pod		RPG-7
Rapier	AMRAAM		BAP 100	Multi-Dart 68 mm		TOW ATGW
SA-7 'Grail'	R550 Magic		BAT 120	Multi-Dart 100 mm		
Sakr Eye			BL 5/6 GP	TDA Pods		
			BL 755 Cluster			
			BL 8/18 Frag			
			Durandal			

Pakistan

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Anza Mk I/II/III	AIM-7 Sparrow	AGM-45 Shrike	100 kg GP Type 1	57 mm Type 1 and 2	122 mm	75 mm
Crotale	AIM-9 Sidewinder	AGM-65 Maverick	250 kg GP Type 2	68 mm SNEB	BM-11 MRS	RCL Type 52
FIM-92A Stinger	AIM-120	AGM-84 Harpoon	250 kg HE	HF-16 B Pod	122 mm BM-21 'Grad' MRS	106 mm RCL M40
HN-5A	PL-5	AM 39 Exocet	Incendiary Type 1	Hydra 70		RPG-7
HQ-2	PL-7	AS 30	250 kg Incendiary Type 1	LAU-130/A Pod		TOW ATGW
LY-60	PL-9	BGM-71 TOW	BL 5/8 GP	LAU-131/A Pod		
Mistral	PL-12	HJ-8	BL 8/18 Frag			
RBS-70	R530	BLU-109	BL 755			
R550 Magic		GBU-10 Paveway II				
SD-10 (unconfirmed)		GBU-12 Paveway II				
		GBU-24 Paveway III				
		GBU-31 JDAM				
		GBU-38 JDAM				
		HAFR-1				
		Mk 81/82/84 GP				
		Mk P8 227 kg				
		PSD-1				
		Raptor II				

Paraguay

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
			AV-BAFG-120	LM-37 Pod (SBAT-37 rockets)		75 mm RCL M20
			AV-BAFG-250	LM-70 Pod (SBAT-70 rockets)		
			AV-BI-200	LM-127 Pod (SBAT-127 rockets)		
			AV-BI-250			
			AV-BP-260			

Peru

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Javelin	AA-2 'Atoll'	AM 39 Exocet	AO Frag	68 mm SNEB	107 mm	106 mm
SA-2 'Guideline'	AA-10 'Alamo'	AS 30L	BL 5/6 GP	B-8M1	RO 107 MRS	RCL M40
SA-3 'Goa'	AA-11 'Archer'	AT-2 'Swatter'	BL 8/18 Frag	80 mm Pod	122 mm BM-21 'Grad' MRS	AT-2 'Swatter'
SA-7 'Grail'	AA-12 'Adder'	AT-3 'Sagger'	BL 61/70 Frag	B-8V20A		AT-3 'Sagger'
SA-14 'Gremlin'	R550 Magic	Paveway II/III LGB	ZAB Incendiary	80 mm Pod		SS-11 ATGW
SA-15 'Gauntlet'			FAB GP	S-5 57 mm		
SA-16 'Gimlet'			ZAB Incendiary	S-8 80 mm		
SA-18 'Grouse'			BL EU2 series	TDA 100 mm		
				UB-16 57 mm Pod		

Philippines

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
	AIM-9 Sidewinder	AGM-65 Maverick	300 kg Napalm	AL-18-50 Pod		75 mm RCL M20
		BGM-71 TOW	BL-18 Frag	Hydra 70		90 mm RCL M67
			BL61 Frag	M260 Pod		106 mm RCL M40A1
			Mk 81/82 GP	M261 Pod		
			SEI 227 kg	SNIA BPD 51 mm		

Poland

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Grom-1	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	B-8M1	122 mm BM-21 'Grad' MRS	40 mm
Grom-2	AA-6 'Acrid'	AS-9 'Kyle'	BetAB	80 mm Pod	122 mm RM-70 MRS	Palad GL
SA-2 'Guideline'	AA-7 'Apex'	AS-10 'Karen'	BRAB AT	B-8V20A	FROG-7 ARS	73 mm SPG-9
SA-3 'Goa'	AA-8 'Aphid'	AS-12 'Kegler'	FAB GP	80 mm Pod		82 mm RCL B-10
SA-4 'Ganef'	AA-10 'Alamo'	AS-14 'Kedge'	FAB-M54 GP	B-13L 122 mm Pod		AT-3 'Sagger'
SA-5 'Gammon'	AA-11 'Archer'	AT-2 'Swatter'	FAB-M62 GP	M-100 137 mm		AT-4 'Spigot'
SA-6 'Gainful'	AIM-9 Sidewinder	AT-3 'Sagger'	KMG-U Dispenser	Mars-2 57 mm Pod		AT-5 'Spandrel'
SA-7 'Grail'	AIM-120 AMRAAM	AT-6 'Spiral'	OFAB	Mars-8 57 mm Pod		RPG-7V
SA-8 'Gecko'	SA-7 'Grail'		RBK-250/275 Cluster	S-5 57 mm		
SA-9 'Gaskin'	SA-14 'Gremlin'		RBK-500 Cluster	S-8 80 mm		
SA-13 'Gopher'			ZAB Incendiary	S-13 122 mm		
SA-14 'Gremlin'			ZK-300	S-24 240 mm		
			'Kisajno' Cluster	UB-16 57 mm Pod		
				UB-32 57 mm Pod		

Portugal

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Blowpipe	AIM-7 Sparrow	AGM-65 Maverick	AA FR 50/200	68 mm SNEB		84 mm RCL
Chaparral	AIM-9 Sidewinder		AA GP 50/100/ 250/400/500	Matra Type F2 Pod		90 mm RCL M67
FIM-92 Stinger	AIM-120 AMRAAM		AA GP LD 125/250/500	TDA 100 mm		106 mm RCL M40
I-HAWK			AA LC 300/500	TDA 100 mm Pod		MILAN ATGW
			BAP 100	SNIA BPD 51 mm		TOW ATGW
			BAT 120	SNIA BPD 81 mm		
			BL 5/6 GP			
			BL 8/18 Frag			
			BL 61 Frag			
			Mk 81/82/84 GP			

Qatar

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Blowpipe	MICA	AM 39 Exocet	BL 5/6 GP	68 mm SNEB	ASTROS MRS	84 mm RCL
FIM-92A Stinger	R550 Magic 2	AS 12	BL 8/18 Frag	Matra M155 Pod		HOT ATGW
Mistral	Super 530D	HOT	BL 61 Frag	TDA 100 mm		MILAN ATGW
Rapier			T 25 andT 200 GP	TDA 100 mm Pod		
Roland 2						
SA-7 'Grail'						

Romania

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
I-HAWK	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	57 mm Pod	122 mm APR-40	73 mm SPG-9
SA-2 'Guideline'	AA-7 'Apex'	AT-2 'Swatter'	BAEF-100P	122 mm Pod	MRS	AT-3 'Sagger'
SA-3 'Goa'	AA-8 'Aphid' (A-95)	AT-3 'Sagger'	BE-50	B-8M1 80 mm Pod	160 mm LAROM	RPG-7V
SA-6 'Gainful'	AA-10 'Alamo'	AT-9 'Spiral'	BE-100	B-13L 122 mm Pod	160 MRS	
SA-7 'Grail'	AA-11 'Archer'	X-5/Spike-LR (NT-D)	BE-250/500E	L-16-42 Pod	FROG-3 ARS	
SA-8 'Gecko'	SA-7 'Grail'		BetAB	L-32-42 Pod	FROG-7 ARS	
SA-9 'Gaskin'	Python 3		BM-100	M-100 137 mm		
S-125 Pechora			BRAB AT	S-5 57 mm		
			CL-250 Cluster	S-8 80 mm		
			FAB GP	S-13 122 mm		
			FAB-M54 GP	S-24 240 mm		
			FAB-M62 GP	UB-16 57 mm Pod		
			KMG-U Dispenser	UB-32 57 mm Pod		
			Lizard LGB			
			OFAB			
			Opher PGM			
			RBK-250/275 Cluster			
			RBK-500 Cluster			
			SEBAv Dispenser			
			ZAB Incendiary			

Russian Federation

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Pantsyr S-1	AA-6 'Acrid'	AS-4 'Kitchen'	AK-2	ARS-212 212 mm	122 mm BM-21	AT-3 'Sagger'
SA-4 'Ganef'	AA-7 'Apex'	AS-7 'Kerry'	AO Frag	B-8V20A 80 mm Pod	'Grad' MRS	AT-4 'Spigot'
SA-5 'Gammon'	AA-8 'Aphid'	AS-10 'Karen'	AOKh	B-8M1 80 mm Pod	122 mm M1975 MRS	AT-5 'Spandrel'
SA-6 'Gainful'	AA-9 'Amos'	AS-11 'Kilter'	BetAB	B-13L 122 mm Pod	122 mm M1976 MRS	RPG-7
SA-7 'Grail'	AA-10 'Alamo'	AS-12 'Kegler'	BRAB AT	C-25D 265 mm	220 mm	RPG-16
SA-8 'Gecko'	AA-11 'Archer'	AS-13 'Kingbolt'	Chemical	M-100 137 mm	'Uragan' MRS	RPG-18
SA-9 'Gaskin'	AA-12 'Adder'	AS-14 'Kedge'	SprayTanks	S-5 57 mm	300 mm BM 9A52	RPG-22
SA-10a/b/c 'Grumble'	R-37M	AS-15 'Kent'	FAB-250/500 GP	S-8 80 mm	'Smerch' MRS	RPG-26
SA-11 'Gadfly'	SA-7 'Grail'	AS-16 'Kidback'	FAB-1000/1500 GP	S-13 122 mm	FROG-7 ARS	RPG-27
SA-12a/b	SA-14 'Gremlin'	AS-17 'Krypton'	FAB-250ShN	S-16 160 mm	TOS-1 MRS	RPG-29
'Gladiator/Giant'	SA-16 'Gimlet'	AS-18 'Kazoo'	FAB 500ShN/T	S-21 220 mm		RPG-30
SA-13 'Gopher'	SA-18 'Grouse'	AS-20 'Kayak'	FAB-M43	S-24 240 mm		SPG-9
SA-14 'Gremlin'		AT-3 'Sagger'	FAB-M46	S-25 325 mm		
SA-15 'Gauntlet'		AT-6/9 'Spiral'	FAB-M54	TRS-190 190 mm		
SA-16 'Gimlet'		AT-12 'Swinger'	FAB-M62	UB-8-57 57 mm Pod		
SA-18 'Grouse'		AT-16	FOZAB-500	UB-16-57 57 mm Pod		
SA-19 'Grison'		S-25LD	FZAB-500	UB-19-57 57 mm Pod		
SA-20			KAB-500L LGB	UB-32-57 57 mm Pod		
SA-21			KAB-500Kr			
			KAB-1500L LGB			
			KhAB Chemical			
			KhAB-25			
			KhAB-100			
			KhAB-200			
			KhAB-500			
			KMG-U Dispenser			
			KraB-25			
			ODAB-500 PM			
			OFAB			
			OFZAB-500			
			OKT-1.5 Bomblet			
			P-50T			
			PFM-1 Bomblet			
			PROSAB-250			
			RBK-250/275 Cluster			
			RBK-500 Cluster			
			RBK-500 AO-2.5 RTM Cluster			
			RBK-500 BetAB Cluster			
			RBK-500 PTAB-1M Cluster			
			RBK-500 ShOAB-0.5 Cluster			
			RBK-500 SPBE Cluster			
			RBK-500 SPBE-D Cluster			
			RBK-500 U Clusters			
			VAP-200			
			VAP-1000			
			ZAB-100/-250			
			Incendiary			
			ZB-500			

Rwanda

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-16 'Gimlet'			BL-5/6 GP BL-8/18 Frag BL-61 Frag	68 mm SNEB Matra F2 Pod S-5 57 mm S-8 80 mm	122 mm RM-70 MRS	RPG-7

Saudi Arabia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Crotale FIM-43 Redeye FIM-92A Stinger I-HAWK III Mistral Patriot SA-16 'Gimlet' Shahine (modified Crotale)	AIM-7 Sparrow AIM-9 Sidewinder R530 R550 Magic Sky Flash	AGM-45 Shrike AGM-65 Maverick AGM-114 Hellfire ALARM AM 39 Exocet AS 15TT (Brimstone) Sea Eagle (Storm Shadow)	227 kg Mk 1/2 GP BL 755 Cluster JP 233 Mk 10/13/18/20 GP Mk 81/82/84 GP Paveway II LGB GBU-28 Paveway III	CRV7 FZ 70 mm FFAR FZ M159 Pod Hydra 70 LAU-130/A Pod LAU-131/A Pod M260 Pod M261 Pod	ASTROS II MRS	75 mm RCL M20 84 mm RCL 90 mm RCL M67 HOT ATGW TOW ATGW

Senegal

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
		AS 11	BL-5/6 GP BL-8/18 Frag BL-61 Frag	68 mm SNEB Matra F2 Pod Matra 181 Pod		MILAN ATGW RPG-7

Serbia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline' SA-3 'Goa' SA-6 'Gainful' SA-7 'Grail' (plus locally improved model) SA-8 'Gecko' SA-9 'Gaskin' SA-10 'Grumble' SA-11 'Gadfly' SA-13 SAVA (locally modified 'SA-13 Gopher') SA-14 'Gremlin' SA-16 'Gimlet'	AA-2 'Atoll' AA-7 'Apex' AA-8 'Aphid' AA-10 'Alamo' AA-11 'Archer' SA-7 'Grail'	AGM-65 Maverick AS-7 'Kerry' AT-2 'Swatter' AT-3 'Sagger' AT-6 'Spiral'	BL 755 DPT-150 Dispenser FAB 100 (M80) GP FAB 250 (M72) Frag FAB 250 (M79) GP FAB 500 GP PLAB-150/-200/-350 PTAB-1.5 HC PTAB-2.5 HC RAB-2.5 Frag RAB-3.5 Frag RAB-16 Frag RAB-120 Cluster ZAB-45 Incendiary	5 in HVAR B-8M1 80 mm Pod B-8V20A 80 mm Pod L-57-07 Pod L-57-16 Pod L-128-04 Pod S-8 80 mm VRZ-57 HE 57 mm VRZ-127 HE 127 mm	122 mm BM-21 'Grad' MRS 128 mm M-63 Plamen-S MRS 128 mm M-77 MRS 128 mm M-85 MRS 262 mm M-87 'Orkan' MRS FROG-7 ARS	44 mm RL M57 64 mm RL RBR-M80 75 mm RCL M20 82 mm RCL M60 105 mm RCL M65 AT-3 'Sagger' Dragon ATGW TOW ATGW

Seychelles

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA 7 a/b 'Grail'					122 mm BM-21 'Grad' MRS	RPG-7

Sierra Leone

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7 'Grail'	SA-7 'Grail'	AT-2 'Swatter' AT-3 'Sagger' AT-6 'Spiral'		B-8V20A 80 mm Pod S-5 57 mm S-8 80 mm UB-32 57 mm Pod		84 mm Carl Gustaf 3.5 in RL M20 RPG-7

Singapore

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-92A Stinger I-HAWK Mistral Rapier RBS 70 SA-18 'Grouse'	AIM-7 Sparrow AIM-9 Sidewinder AIM-120C AMRAAM Python IV	AGM-45 Shrike AGM-65 Maverick AGM-114 Hellfire AM 39 Exocet BGM-71 TOW	250 kg GP (AGM-154) BAP 33 BAP 106 (GBU-31/38 JDAM) Mk 81/82/84 GP Paveway II LGB	CRV7 Hydra 70 LAU-61 Pod LAU-68 Pod		84 mm Carl Gustaf 106 mm RCL M40 Armbrust MILAN ATGW Spike ATGW

Slovakia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline' SA-3 'Goa' SA-5 'Gammon' SA-6 'Gainful' SA-7 'Grail' SA-9 'Gaskin' SA-10b 'Grumble' SA-13 'Gopher' SA-14 'Gremlin' SA-16 'Gimlet'	AA-2 'Atoll' AA-7 'Apex' AA-8 'Aphid' AA-10 'Alamo' AA-11 'Archer' SA-7 'Grail' SA-14 'Gremlin'	AS-7 'Kerry' AS-10 'Karen' AS-11 'Kilter' AS-12 'Kegler' AS-14 'Kedge' AT-2 'Swatter' AT-3 'Sagger' AT-6 'Spiral'	AO Frag BetAB BRAB AT FAB GP FAB-M54 GP FAB-M62 GP KMG-U Dispenser OFAB Phobos (anti-runway) RBK-250/275 Cluster RBK-500 Cluster ZAB Incendiary	B-8M1 80 mm Pod B-8V20A 80 mm Pod B-13L 122 mm Pod M-100 137 mm S-5 57 mm S-8 80 mm S-13 122 mm S-24 240 mm S-25 325 mm UB-16 57 mm Pod UB-32 57 mm Pod	122 mm RM-70 MRS FROG-7 ARS	AT-3 'Sagger' RPG-75

Slovenia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Pantsyr-S1				70 mm Pod	126 mm M-63	Armbrust
Roland 2					Plamen-S MRS	AT-3 'Sagger'
SA-7 'Grail'						
SA-9 'Gaskin'						

Somalia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
					122 mm BM-21 'Grad' MRS	89 mm LRAC
					132 mm BM-13 MRS	AT-3 'Sagger'
					140 mm BM-14-16 MRS	MILAN ATGW
					140 mm BM-14-17 MRS	RPG-2
					240 mm BM-24 MRS	RPG-7

South Africa

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Crotale	Darter V3C	AS 12	12.5 kg Practice	FZ 70 mm FFAR	127 mm	92 mm FT-5
SA-7 'Grail'	Kukri V3B	AS 30	120 kg Frag	FZ M-159 Pod	Valkiri MRS	106 mm M40 RCL
SA-14 'Gremlin'	Mistral ATAM	AM 39 Exocet	120 kg GP	Matra Type 155 Pod	127 mm	MILAN ATGW
SAHV-3	R530	AGM-114 Hellfire	250 kg GP	Multi-Dart 68 mm	Bataleur MRS	RPG-7
(locally modified Crotale)	R550 Magic	BGM-71 TOW	250 kg Practice			XT3 ATGW
Starstreak	R-Darter	Raptor 2	400 kg Frag			
	Shafrir 2	ZT-3 Swift	440 kg SI/Frag			
	U-Darter	ZT-35	480 kg GP			
		(ZT-6 Mokopa)	ADBS 145			
			CB 470 Cluster			
			Mk 81/82/83 Pre-Frag			
			Raptor 1/2			
			Supercross			
			Retard System			

Spain

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Aspide Mk 1	AIM-7 Sparrow	AGM-65 Maverick	ABL 250 Cluster	CASA Pods	140 mm Teruel MRS	66 mm M72A3
Aspide 2000	AIM-9 Sidewinder	AGM-88 HARM	ALD GP/FRAG Family	CRV7		89 mm RL M89
FIM-92 Stinger	AIM-120 AMRAAM	HOT	ASH Retarded	Hydra 70		106 mm RCL M40A1
I-HAWK	Magic	Taurus KEPD 350	BIN Incendiary	INTA S9		C-90-C
Mistral	R530		BME 330 AR Cluster	INTA S11		Dragon ATGW
NASAMS	R550		MBE 330 AT Cluster	INTA S12		MILAN ATGW
Patriot			BME 330 C Cluster	LAU-130/A Pod		TOW ATGW
Roland			BR GP Low Drag	LAU-131/A Pod		
			BRFA 330 Penetration	Snora 81 mm		
			BRP Retarded	TDA LR 60 Pod		
			BRPS Retarded			
			Paveway II/III LGB			

Sri Lanka

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Igla	PL-2/3	AT-2 'Swatter'	100 kg GP Type 1	57 mm Type 1 and 2	122 mm RM-70 MRS	73 mm PG-9
	PL-5	AT-3 'Sagger'	250 kg GP Type 2	AL-18-50 Pod		82 mm RCL M60
	Python III		BK-BR	Aspide 1057		106 mm RCL M40
			BRP/BRPS/FAS	HF-16B Pod		
			FAB GP	S-5 57 mm		
				SNIA BDP 51 mm		
				UB-16 57 mm Pod		

Sudan

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-43 Redeye	AA-2 'Atoll'	AGM-65 Maverick	100 kg GP Type 1	57 mm Type 1 and 2	107 mm	RPG-7
FN-6	AA-7 'Apex'	AS-7 'Kerry'	250 kg GP Type 2	B-8M1 80 mm	Type 63 MRS	
SA-2 'Guideline'	AA-8 'Aphid'	AT-3 'Sagger'	AO Frag	B-8V20A 80 mm Pod	122 mm BM-21 'Grad' MRS	
SA-7 'Grail'	AA-10 'Alamo'	AT-6 'Spiral'	BetAB	HF-16B Pod	122 mm Sakr MRS	
	AA-11 'Archer'	HOT	BRAB AT	S-5 57 mm		
	AIM-9 Sidewinder		FAB GP	S-8 80 mm		
	PL-2/3		FAB-M54 GP	S-24 240 mm		
	PL-5		KMG-U Dispenser	UB-32 57 mm Pod		
	SA-7 'Grail'		Mk 81/82/84 GP			
			ZAB Incendiary			

Sweden

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
I-HAWK	AIM-9 Sidewinder	AGM-65 Maverick	DWS 39			84 mm AT-4
RBS-23	AIM-120 AMRAAM	BGM-71 TOW	Paveway II LGB			RBS 56 BILL ATGW
RBS-70	Sky Flash	RBS15F				TOW ATGW
RBS-90						
RBS-96						
RBS-97						

Switzerland

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-92D Stinger	AIM-9 Sidewinder	AGM-65 Maverick	BL 5/6 GP	RAK 025/026/030 Pods		83 mm RL RR50
Rapier	AIM-120B AMRAAM		BL 8/18 Frag	RWK 020 Pod		83 mm RL RR58
			BL 61 Frag	SNORA 81 mm		106 mm RCL M40
			Mk 81/82/84 GP	SURA-D 81 mm		Dragon ATGW
						TOW ATGW

Syria

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Pantsyr-S1	AA-2 'Atoll'	AS 11	AO Frag	B-8M1 80 mm Pod	107 mm	AT-3 'Sagger'
SA-2 'Guideline'	AA-6 'Acrid'	AS 12	BetAB	B-8V20A	Type 63 MRS	AT-4 'Spigot'
SA-3 'Goa'	AA-7 'Apex'	AS-7 'Kerry'	BRAB AT	80 mm Pod	122 mm BM-21	AT-IX-14 Kornet
SA-5 'Gammon'	AA-8 'Aphid'	AS 9 'Kyle'	FAB GP	B-13L 122 mm Pod	'Grad' MRS	MILAN ATGW
SA-6 'Gainful'	AA-10 'Alamo'	AS-10 'Karen'	FAB-M54 GP	M-100 137 mm	FROG-7 ARS	RPG-7
SA-7 'Grail'	AA-11 'Archer'	AS-12 'Kegler'	FAB-M62 GP	S-5 57 mm		SPG-9
SA-8 'Gecko'	SA-7 'Grail'	AT-2 'Swatter'	KMG-U Dispenser	S-8 80 mm		
SA-9 'Gaskin'	SA-14 'Gremlin'	AT-3 'Sagger'	OFAB	S-13 122 mm		
SA-10 'Grumble'		AT-6 'Spiral'	RBK-250/275 Cluster	S-24 240 mm		
SA-11 'Gadfly'		HOT	RBK-500 Cluster	S-25 325 mm		
SA-13 'Gopher'			ZAB Incendiary	UB-16 57 mm Pod		
SA-14 'Gremlin'				UB-32 57 mm Pod		
SA-18 'Grouse'						

Taiwan

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Avenger	AIM-7 Sparrow	AGM-114 Hellfire	BLU Fire Bombs	CRV7	117 mm 'Kung	3.5 in RL M20
Chaparral	AIM-9	AGM-12 Bullpup	CBU-24/49/52	Hydra 70	Feng VI' MRS	66 mm M72
FIM-92 Stinger	Sidewinder	AGM-65 Maverick	CBU-58/71	LAU-130/A Pod	126 mm 'Kung	84 mm AT4
HAWK	AIM-120C	AGM-84 Harpoon	M117	LAU-131/A Pod	Feng III' MRS	90 mm RCL M67
Mistral	AMRAAM	BGM-71 TOW	Mk 7 Dispenser	M260 Pod	126 mm 'Kung	106 mm
Patriot	MICA	Hsiung Feng 2	(Rockeye)	M261 Pod	Feng IV' MRS	RCL M40
Sky Sword 1	R 550 Magic 2		Mk 81/82/84 GP		RT 2000 ARS	Apilas
(aka Antelope)	Sky Sword 1		Paveway II LGB			TOW ATGW
Tien Kung I	Sky Sword 2					
Tien Kung II						

Tajikistan

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline'		AT-2 'Swatter'		B-8V20A Pod	122 mm BM-21	73 mm SPG-9
SA-3 'Goa'		AT-3 'Sagger'		B-13L 122 mm Pod	'Grad' MRS	AT-3 'Sagger'
SA-7 'Grail'		AT-6 'Spiral'		S-5 57 mm	220 mm BM 9P140	RPG-7
SA-8 'Gecko'				S-8 80 mm	'Uragan' MRS	
SA-14 'Gremlin'				S-13 122 mm		
SA-18 'Gimlet'				UB-16 57 mm Pod		
				UB-32 57 mm Pod		

Tanzania

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-3 'Goa'	PL-2/3		100 kg Type 1 GP	57 mm Type 1 and 2	122 mm BM-21	75 mm RCL
SA-6 'Gainful'	PL-5		100 kg Type 2 GP	HF-16B Pod	'Grad' MRS	Type 52
SA-7 'Grail'			250 kg Type 2 GP			RPG-7
SA-9 'Gaskin'			250 kg Type 1			TOW ATGW
			Incendiary			

Thailand

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
ADATS	AIM-9 Sidewinder	AGM-84 Harpoon	BL-755 CBU	CRV7	70 mm MRS	66 mm M72 LAW
Aspide Mk 1	AIM-120B	AGM-65 Maverick	Mk 81/82/84 GP	Hydra 70	122 mm	106 mm
Blowpipe	AMRAAM	BGM-71 TOW	Paveway I/II LGB	LAU-130/A Pod	Type 83 MRS	RCL M40
FIM-43 Redeye	Python 3			LAU-131/A Pod	130 mm	Dragon ATGW
HN-5A	Python 4			M260 Pod	Type 85 MRS	TOW ATGW
Mistral				M261 Pod	130 mm MRS	
RBS 70				S-5 57 mm		
				UB-16 57 mm Pod		

Togo

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
			AV BAFG	68 mm SNEB		57 mm RCL M18
			AV-B1	Matra Type F2 Pod		75 mm RCL Type 56
			BL 5/6 GP	Matra M155 Pod		82 mm RCL Type 65
			BL 8/18 Frag	SBAT 37 mm		89 mm LRAC
			BL 61 Frag	SBAT 70 mm		RPG-7
			T 25 and 200 GP			

Tunisia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Chaparral	AIM-9 Sidewinder	AGM-65 Maverick	BL7 115 kg GP	68 mm SNEB		3.5 in RL M20
RBS-70			BL9 120 kg Frag	Hydra 70		106 mm
			Mk 81/82/84 GP	LAU-130/A Pod		RCL M40A1
			SEI Low Drag	LAU-131/A Pod		MILAN ATGW
				S-5 57 mm		TOW ATGW

Tunisia — *continued*

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
				TDA 68 mm Pod UB-16 57 mm Pod		

Turkey

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-43 Redeye	AIM-7 Sparrow	AGM-12 Bullpup	CBU-87 (CEM)	CRV7	107 mm MRS	3.5 in RCL
FIM-92A/C Stinger	AIM-9 Sidewinder	AGM-45 Shrike	Mk 81/82/84 GP	Hydra 70	122 mm T-122 MRS	66 mm LAW M72
I-HAWK	AIM-120 AMRAAM	AGM-65 Maverick	Paveway VII	LAU-130/A Pod	227 mm MLRS	106 mm RCL M40
Nike-Hercules	FIM-92 Stinger	AGM-84K SLAM-ER		M260 Pod	320 mm WS-1 ARS	Eryx ATGW
Rapier		AGM-88 HARM		M261 Pod		MILAN ATGW
		AGM-114 Hellfire				TOW ATGW
		BGM-71 TOW				
		Popeye				
		Sea Skua				

Turkmenistan

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline'	AA-2 'Atoll'	AS-7 'Kerry'	FAB GP	S-5 57 mm	122 mm BM-21	73 mm SPG-9
SA-3 'Goa'	AA-7 'Apex'	AS-9 'Kyle'		S-8 80 mm	'Grad' MRS	AT-3 'Sagger'
SA-5 'Gammon'	AA-8 'Aphid'	AS-10 'Karen'			220 mm BM 9P140	AT-4 'Spigot'
SA-7 'Grail'	AA-10 'Alamo'	AS-12 'Kegler'			'Uragan' MRS	AT-5 'Spandrel'
SA-8 'Gecko'	AA-11 'Archer'	AS-14 'Kedge'			FROG-7 ARS	RPG-7
SA-13 'Gopher'		AT-3 'Sagger'				
SA-14 'Gremlin'						
SA-16 'Gimlet'						

Uganda

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7a/b 'Grail'	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	AL-18-50 Pod	122 mm BM-21	AT-3 'Sagger'
			BL-7	S-5 57 mm	'Grad' MRS	RPG-7
			BL-9	S-8 80 mm		
			FAB GP	S-24 240 mm		
			SEI 227 kg	SNIA BPD 51 mm		
			ZAB Incendiary	UB-16 57 mm Pod		
				UB-32 57 mm Pod		

Ukraine

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline'	AA-2 'Atoll'	AS-4 'Kitchen'	AO Frag	B-8M1	122 mm BM-21	73 mm SPG-9
SA-3 'Goa'	AA-6 'Acrid'	AS-6 'Kingfish'	BetAB	80 mm Pod	'Grad' MRS	AT-3 'Sagger'
SA-4 'Ganef'	AA-7 'Apex'	AS-7 'Kerry'	BRAB AT	B-8V20A	132 mm	AT-4 'Spigot'
SA-5 'Gammon'	AA-8 'Aphid'	AS-9 'Kyle'	Chemical	80 mm Pod	BM-13 MRS	AT-5 'Spandrel'
SA-6 'Gainful'	AA-9 'Amos'	AS-10 'Karen'	Spray Tanks	B-13L	220 mm BM 9P140	AT-6 'Spiral'
SA-7 'Grail'	AA-10 'Alamo'	AS-11 'Kilter'	FAB GP	122 mm Pod	'Uragan' MRS	AT-11
SA-8 'Gecko'	AA-11 'Archer'	AS-12 'Kegler'	FAB-250ShN	M-100 137 mm	300 mm BM 9A52	RPG-7
SA-10 'Grumble'	SA-7 'Grail'	AS-13 'Kingbolt'	FAB-500ShN	S-5 57 mm	'Smerch' MRS	
SA-11 'Gadfly'	SA-14 'Gremlin'	AS-14 'Kedge'	FAB-M54	S-8 80 mm	FROG-7 ARS	
SA-12a/b	SA-16 'Gimlet'	AS-15 'Kent'	FAB-M62	S-13 122 mm		
'Gladiator/Giant'		AS-16 'Kickback'	KAB-500L LGB	S-16 160 mm		
SA-14 'Gremlin'		AT-2 'Swatter'	KAB-500Kr	S-21 220 mm		
SA-15 'Gauntlet'		AT-3 'Sagger'	KAB-1500L LGB	S-24 240 mm		
SA-16 'Gimlet'		AT-6 'Spiral'	KhAB Chemical	S-25 325 mm		
SA-18 'Grouse'			KMG-U Dispenser	UB-16-57 57 mm Pod		
			OFAB	UB-32-57 57 mm Pod		
			OFZAB-500			
			RBK-250/275 Cluster			
			RBK-500 Cluster			
			ZAB Incendiary			

United Arab Emirates

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Crotale	AIM-9	AGM-114 Hellfire	227 kg GP Mk 1/2	68 mm SNEB	70 mm (40-round)	84 mm
I-HAWK	Sidewinder	AM 39 Exocet	BAP 100	Hydra 70	LAU97 MRS	Carl Gustaf
Mistral	AIM-120B	AS 12	BAT 120	Matra Pods	122 mm FIROS-30	HOT ATGW
Rapier	AMRAAM	AS 15TT	BL 5/6 GP	Multi-Dart 68 mm	MRS	MILAN ATGW
RBS 70	MICA	Black Shaheen	BL 755 Cluster	Multi-Dart 100 mm	122 mm	TOW ATGW
Pantsyr S1	R550 Magic	Hakeem PGM	BL 9/18 Frag	TDA Pods	Type 90 MRS	
(unconfirmed)		HOT	SEI Low Drag		227 mm HIMARS	
SA-14 'Gremlin'					300 mm BM 9A52	
SA-16 'Gimlet'					'Smerch' MRS	

United Kingdom

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Rapier	AIM-9	ALARM	3 kg/14 kg	68 mm SNEB	227 mm MLRS	Javelin
Starstreak	Sidewinder	AGM-65 Maverick	Practice Bombs	CRV7		LAW-80
Javelin	ASRAAM	AGM-84 Harpoon	227 kg GP Mk 1/2	Hydra 70		MILAN ATGW
Starburst	Sky Flash	BGM-71 TOW	454 kg GP Mk	LAU series 70 mm		TOW ATGW
	AIM-120		10/13/18/20/22			
	AMRAAM		Enhanced Paveway			
			II/III LGB			

United Kingdom — *continued*

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-92A/C Stinger		Brimstone Sea Skua Storm Shadow	Paveway II/III LGB JP 233 RBL 755 CBU SG 357 Submunition	M261 Launcher Matra Pods Multi-Dart 100 mm Multi-Dart 68 mm RA 79		

United States

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
FIM-92A/B/C/E Stinger Patriot	AIM-120A/B/C AMRAAM AIM-54 Phoenix AIM-7 Sparrow AIM-9 Sidewinder FIM-92 Stinger	ADM-141 TALD AGM-65 Maverick AGM-84D Harpoon AGM-84E SLAM AGM-86 ALCM AGM-88 HARM AGM-114 Hellfire AGM-119 Penguin AGM-122 Sidearm AGM-123A Skipper II AGM-129 ACM AGM-130 AGM-142 Popeye AGM-158 JASSM BGM-71 TOW	AGM-154 JSOW B57 Nuclear B61 Nuclear B83 Nuclear BLU-107/B BLU-109/B BLU-82 6,800 kg CBU-55/B CBU-72 CBU-87/B (CEM) CBU-94/B CBU-97/B (SFW) CBU-107 PAW GATOR Mine System GBU-15 GBU-27 GBU-28 GBU-31/-32/-35 JDAM GBU-39 SDB LGTR/MCDW M 117 M70/78/79/113/125 MOAB Mk 116 Mk 6/7 Dispenser (Rockeye) Mk 81/82/83/84 GP Mk 84 GGM Mk 94 Paveway II/III LGB System SUU-30 Dispenser WCMD	CRV7 Hydra 70 LAU-3 Pod LAU-61 Pod LAU-68 Pod LAU-130/A Pod LAU-131/A Pod M200 Pod M260 Pod M261 Pod Mk 4 Mk 40 ZUNI	227 mm MLRS 227 mm HIMARS	66 mm M72 LAW Dragon ATGW FFV AT-4 Javelin ATGW M136 LAW TOW ATGW

Uruguay

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
		Martin Pescador	BK-BR BRP/BRPS/FAS	Aspid 1057 CBAS-1 Albatros Mamboretta 657 Pod	122 mm RM-70 MRS	106 mm RCL M40A1 MILAN ATGW

Uzbekistan

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline' SA-3 'Goa' SA-5 'Gammon' SA-7 'Grail' SA-14 'Gremlin' SA-16 'Gimlet'	AA-8 'Aphid' AA-10 'Alamo' AA-11 'Archer'	AS-7 'Kerry' AS-9 'Kyle' AS-10 'Karen' AS-11 'Kilter' AS-12 'Kegler' AS-14 'Kedge' AT-3 'Sagger' AT-6 'Spiral'	FAB GP KMG-U Dispenser	B-8V20A 80 mm Pod S-5 57 mm S-8 80 mm UB-16 57 mm Pod UB-32 57 mm Pod	122 mm BM-21 'Grad' MRS FROG-7 ARS	RPG-7 AT-3 'Sagger' AT-4 'Spigot'

Venezuela

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
Barak RBS 70 Roland 2	AIM-7 Sparrow AIM-9 Sidewinder Python 4 R530 R550 Magic 1/2	AGM-45 Shrike AGM-65 Maverick AM 39 Exocet AS 30 L Marte 2	Durandal Mk 81/82/84 GP Whizzard series LGB	CRV7 Hydra 70 LAU-130/A LAU-131/A	160 mm LARS MRS	84 mm AT-4 106 mm RCL M40 SS-11 ATGW

Vietnam

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline' SA-3 'Goa' SA-6 'Gainful' SA-7 'Grail' SA-9 'Gaskin'	AA-11 'Archer' AA-2 'Atoll' AA-6 'Acrid' AA-8 'Aphid' AA-10 'Alamo'	AGM-65 Maverick AS-7 'Kerry' AS-9 'Kyle' AS-10 'Karen' AS-12 'Kegler'	AO Frag BetAB BRAB AT FAB GP FAB-M54 GP	B-8M1 80 mm B-8V20A 80 mm Pod B-13L 122 mm Pod S-5 57 mm S-8 80 mm	107 mm Type 63 MRS 122 mm BM-21 'Grad' MRS 130 mm Type 63 MRS 140 mm BM-14-16 MRS	73 mm SPG-9 75 mm RCL Type 52, 57 82 mm RCL B-10 107 mm RCL B-11 AT-3 'Sagger'

Vietnam — *continued*

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-10 'Grumble'	AIM-9 'Sidewinder'	AT-2 'Swatter'	KMG-U Dispenser	S-13 122 mm		RPG-2
SA-14 'Gremlin'	SA-7 'Grail'	AT-3 'Sagger'	ZAB Incendiary	S-24 240 mm		RPG-7
SA-16 'Gimlet'				UB-16 57 mm Pod		
SA-18 'Grouse'				UB-32 57 mm Pod		

Yemen

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-2 'Guideline'	AA-2 'Atoll'	AS-7 'Kerry'	AO Frag	57 mm Type 1 and 2	122 mm BM-21	66 mm M72 LAW
SA-3 'Goa'	AA-7 'Apex'	AT-2 'Swatter'	BetAB	B-8 80 mm	'Grad' MRS	73 mm SPG-9
SA-6 'Gainful'	AA-8 'Aphid'	AT-3 'Sagger'	BRAB AT	B-8M1 80 mm Pod	140 mm	75 mm RCL M20
SA-7 'Grail'	AA-10 'Alamo'		FAB GP	B-8V20A 80 mm Pod	BM-14 MRS	AT-3 'Sagger'
SA-9 'Gaskin'	AA-11 'Archer'		FAB-M54 GP	B-13L 122 mm Pod	220 mm BM 9P140	Dragon ATGW
	AIM-9 'Sidewinder'		KMG-U Dispenser	HF-16B Pod	'Uragan' MRS	RPG-7
	SA-7 'Grail'		ZAB Incendiary	S-5 57 mm	FROG-7 ARS	TOW ATGW
				S-13 122 mm		
				S-24 240 mm		
				UB-16 57 mm Pod		
				UB-32 57 mm Pod		

Zambia

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-3 'Goa'	AA-2 'Atoll'	AS-7 'Kerry'	100 kg Type 1/2 GP	57 mm Type 1 and 2	122 mm BM-21	44 mm RM M57
SA-7 'Grail'	PL-2/3	AT-2 'Swatter'	250 kg Type 2 GP	HF-16B Pod	'Grad' MRS	57 mm RCL M18
		AT-3 'Sagger'	AO Frag	S-5 57 mm		75 mm RCL M20
			BetAB	UB-16 57 mm Pod		84 mm Carl Gustaf
			BRAB AT	UB-32 57 mm Pod		AT-3 'Sagger'
			FAB GP			RPG-7
			SEI Low Drag			
			ZAB Incendiary			

Zimbabwe

SAM	AAM	ASM	Bombs	Rockets – air	Rockets – ground	Anti-tank
SA-7a/b 'Grail'	PL-2/3		100 kg Type 1 GP	57 mm Type 1 and 2	107 mm	40 mm Type 69
HQ-2	PL-5		100 kg Type 2 GP	68 mm	Type 63 MRS	106 mm RCL M40
(unconfirmed)	PL-7		250 kg Type 2 GP	90 mm Type 1	122 mm	107 mm RCL B-12
			250 kg Type 1 Incendiary	AL-18-50 Pod	RM-70 MRS	RPG-7
			250 kg Type 1 HE Incendiary	HF-16B 57 mm Pod		
			227 kg Mk 1/2	HF-7 90 mm Pod		
			BL7 115 kg GP	SNIA BPD 51 mm		
			BL9 120 kg Frag	TDA 68 mm Pod		
			SEI 227 kg			

PRODUCTION

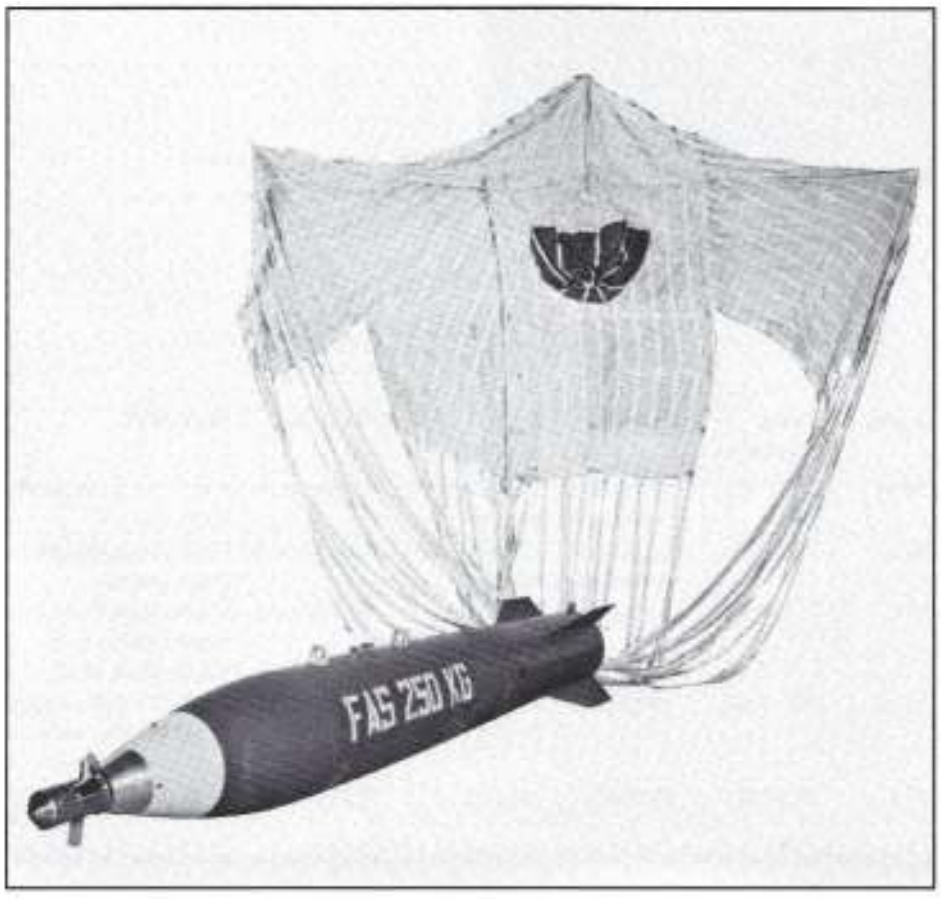
HE Bombs

Argentina

General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BK-BR 50	50 kg	*Note 1*	n/k	n/k	*Note 2*	250 or 356 mm	in service	
BK-BR 125	125 kg	*Note 1*	1.8 m	228 mm	*Note 2*	250 or 356 mm	in service	similar to US Mk 81
BK-BR 250	250 kg	*Note 1*	2.2 m	273 mm	*Note 2*	250 or 356 mm	in service	similar to US Mk 82
BK-BR 500	500 kg	*Note 1*	3.0 m	350 mm	*Note 2*	250 or 356 mm	in service	similar to US Mk 83
BFA-230/2	230 kg	*Note 1*	n/k	n/k	*Note 3*	356 mm	in service	low drag
BRP 50	50 kg	*Note 1*	n/k	n/k	*Note 3*	250 or 356 mm	in service	*Note 4*
BRP 125	125 kg	*Note 1*	n/k	n/k	*Note 3*	250 or 356 mm	in service	*Note 4*
BRP 250	250 kg	*Note 1*	n/k	n/k	*Note 3*	250 or 356 mm	in service	*Note 4*
BRP 500	500 kg	*Note 1*	n/k	n/k	*Note 3*	250 or 356 mm	in service	*Note 4*
BRPS 125	125 kg	*Note 1*	n/k	n/k	*Note 3*	250 or 356 mm	in service	*Note 4*
BRPS 250	250 kg	*Note 1*	n/k	n/k	*Note 3*	250 or 356 mm	in service	*Note 4*
BRPS 500	500 kg	*Note 1*	n/k	n/k	*Note 3*	250 or 356 mm	in service	*Note 4*
FAS 250	250 kg	*Note 1*	n/k	n/k	*Note 3*, including 76 mm nose fuzes	250 or 356 mm	in service	*Note 4*

Note 1: Explosive may be TNT, Tritonal or H-6.
Note 2: Mechanical M1 Mod 2 or M2181 nose fuzes, M2 Mod 2 or M2282 tail fuzes are recommended.
Note 3: These bombs accept a variety of 50 mm electronic nose and tail fuzes, and also the ELEAS 08 RV long-delay side fuze.
Note 4: Parachute-retarded, low drag.



FAS 250 with 76 mm nose fuze and retarding parachute
0504428

Brazil

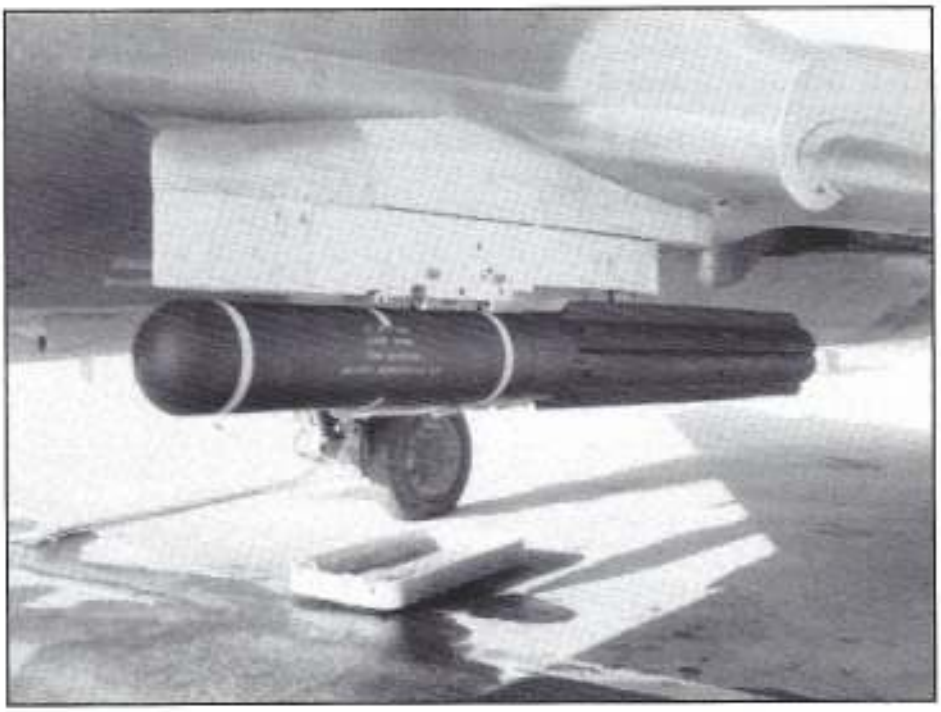
General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
AV-BAFG-120	120 kg	*Note 1*	1.8 m	230 mm	various, N/T	356 mm	in service	low drag
AV-BAFG-250	250 kg	*Note 1*	2.2 m	270 mm	various, N/T	356 mm	in service	low drag
AV-BAFG-920	920 kg	*Note 1*	3.8 m (est)	460 mm (est)	various, N/T	762 mm	in service	believed to be similar to US Mk 84
BFA-230/2	230 kg	HE	n/k	n/k	n/k	356 mm	in service	

Penetrating bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
AV-BP-250	250 kg	HE	3.0 m	230 mm	short delay	356 mm	in service	rocket-assisted penetrator

Note 1: Explosive may be TNT, Tritonal or H-6. Smoke and inert versions are also produced.



AV-BP-250 penetration bomb
0504430

Bulgaria

Fragmentation bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
OFAB 100NV	156 kg	36 kg HE	1.26 m	280 mm	impact, nose/tail	250 mm or single	in service	high drag Russian type bomb
OFAB 100-120	n/k	42 kg HE	1.06 m	273 mm	impact, nose/tail	250 mm or single	in service	high drag Russian type bomb
OFAB 100-120 with brake	138 kg	42 kg HE	1.3 m	273 mm	impact	250 mm or single	in service	high drag Russian type bomb with parachute brake
OFAB 250-270 with brake	302 kg	97 kg HE	1.75 m	325 mm	impact	250 mm	in service	high drag Russian type bomb with parachute brake
P-50-75	72 kg	1.4 kg HE	1.06 m	202 mm	impact	single	in service	practice bomb

Note: These bombs appear to be copies of early Russian designs and have cylindrical high-drag bodies (see *Russian Federation bombs*).

Chile

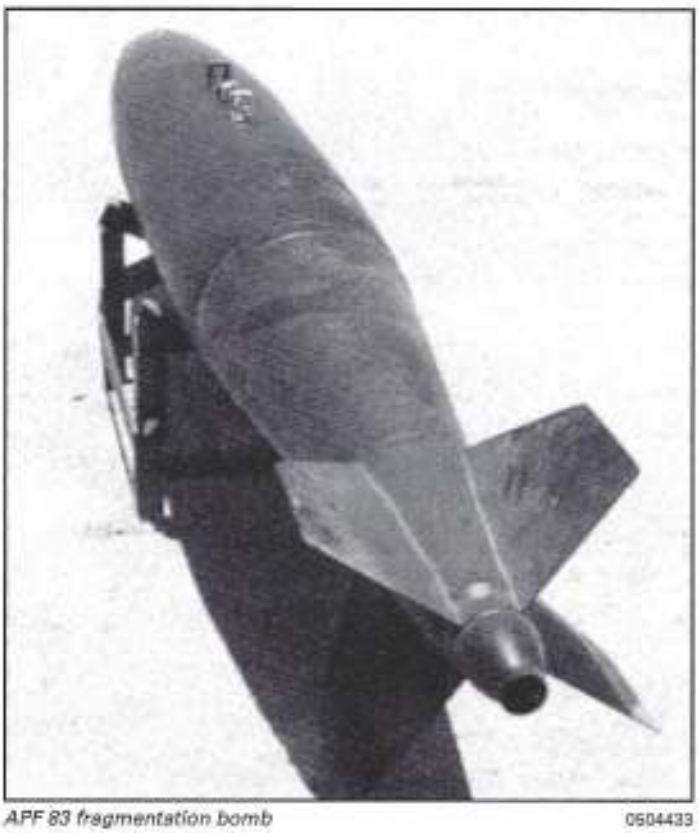
General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
FAMAE Mk 81	120 kg	47 kg *Note 1*	1.92 m	220 mm	various, nose/tail	250 or 356 mm or single	in service	*Note 2*
FAMAE Mk 82	240 kg	95 kg *Note 1*	2.35 m	273 mm	various, nose/tail	250 or 356 mm or single	in service	*Note 2*
FAMAE Mk 83	425 kg	191 kg *Note 1*	2.58 m	355 mm	various, nose/tail	250 or 356 mm or single	in service	*Note 2*
FAMAE Mk 84	908 kg	450 kg *Note 1*	3.3 m	455 mm	various, nose/tail	762 mm	in service	*Note 2*
Cardoen Mk 81	121 kg	45 kg *Note 1*	1.81 m	228 mm	various, nose/tail	250 or 356 mm or single	in service	*Note 2*
Cardoen Mk 82	230 kg	90 kg *Note 1*	2.17 m	274 mm	various, nose/tail	250 or 356 mm or single	in service	*Note 2*
Cardoen Mk 83	416 kg	188 kg *Note 1*	2.89 m	356 mm	various, nose/tail	250 or 356 mm or single	in service	*Note 2*
Cardoen Mk 84	900 kg	443 kg *Note 1*	3.69 m	457 mm	various, nose/tail	762 mm	in service	*Note 2*

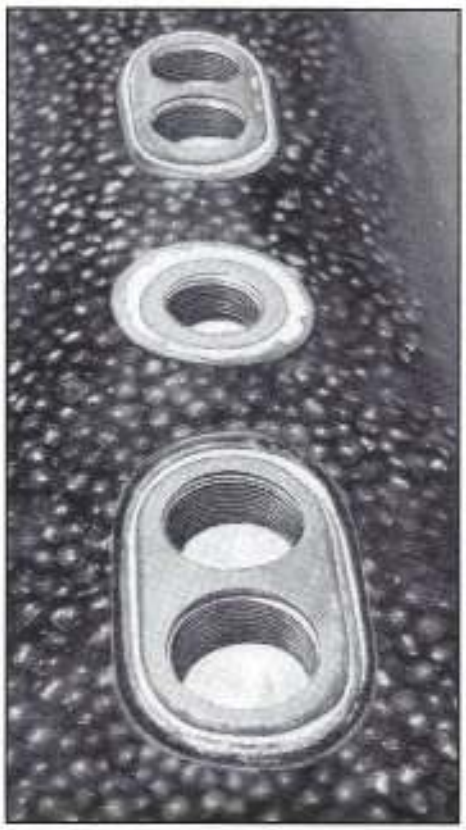
Note 1: Filling may be Tritonal or Hexolite.
Note 2: All are low-drag, based on the US Mk 80 series, and can be fitted with retard mechanisms.

Fragmentation bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
3.5 kg AP bomb	3.3 kg	0.4 kg TNT	0.43 m	78 mm	impact, nose	n/a	in service	looks similar to a mortar bomb
APF 82	230 kg	22 kg Tritonal	2.17 m	274 mm	impact or proximity	single, 250 and 356 mm	in service	uses steel fragments set into a clear resin
APF 83	436 kg	65 kg Tritonal	2.89 m	356 mm	impact or proximity	single, 250 and 356 mm	in service	uses steel fragments set into a clear resin
APF 84	900 kg	190 kg Tritonal	3.69 m	459 mm	impact or proximity	250 and 356 mm	in service	uses steel fragments set into a clear resin
PJ-1	3 kg	0.8 kg HE	0.5 m	85 mm	impact, tail	n/a	in service	looks similar to a mortar bomb



APF 83 fragmentation bomb 0504433



Encapsulated fragments in the APF 83 bomb 0504434

China

General purpose bombs

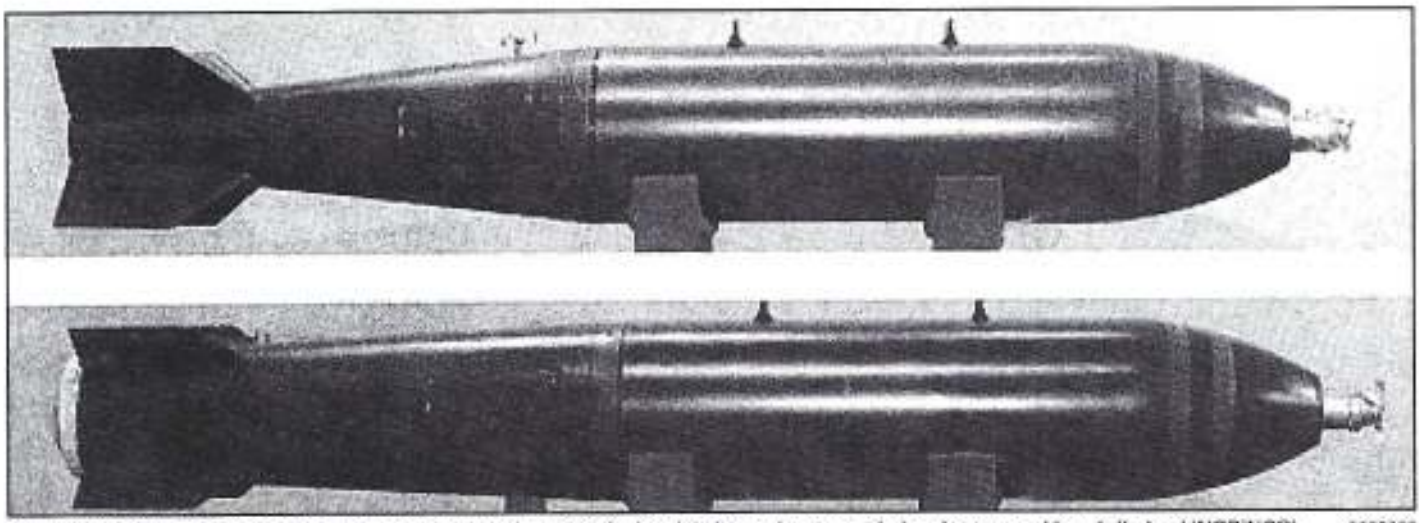
Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
250 kg low drag	217 kg	91 kg TNT	2.1 m	280 mm	various, nose/tail	356 mm	in service	similar to US Mk 82
500 kg low drag	469 kg	220 kg TNT	2.87 m	377 mm	various, nose/tail	356 mm	in service	similar to US Mk 83
1,000 kg low drag	980 kg	431 kg TNT	3.5 m	500 mm	various, nose/tail	762 mm	in service	similar to US Mk 84
100 kg Type 1	80 kg	Pyrotechnic mixture	1.08 m	280 mm	impact, nose	single	in service	high-drag non-HE marker bomb
100 kg Type 2	100 kg	39 kg TNT	1.08 m	280 mm	impact, nose/tail	single	in service	high drag
250 kg Type 2	236 kg	97 kg TNT	1.5 m	325 mm	impact, note/tail	single and 250 mm	in service	high drag
500 kg Type 2	473 kg	200 kg TNT	1.5 m	450 mm	impact, nose/tail	n/k	in service	high drag
1,500 kg Type 2	1,488 kg	658 kg TNT	2.77 m	630 mm	impact, nose/tail	n/k	in service	high drag
3,000 kg Type 2	2,840 kg	1,350 kg TNT	3.3 m	820 mm	impact, nose/tail	n/k	in service	high drag

Fragmentation bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
5 kg Type 1	4.34 kg	0.5 kg TNT	0.38 m	65 mm	impact, nose	n/a	in service	used mainly as a submunition
250 kg low drag	250 kg	n/k	2.08 m	299 mm	nose/tail, type n/k	250 or 356 mm	in service	anti-personnel
250 kg low drag retarded	250 kg	n/k	2.15 m	299 mm	nose/tail, type n/k	250 or 356 mm	in service	

Laser guided bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
500 kg LGB	560 kg	220 kg TNT	3.68 m	377 mm	various nose/tail	250 or 356 mm	believed to be in service	offered for export
LT-2	496 kg	n/k	3.68 m	377 mm	n/k	n/k	believed to be in service	Laser designated targeting



Chinese 250 kg low-drag fragmentation bomb (above) and 250 kg low-level parachute-retarded anti-personnel bomb (below) (NORINCO) 0022888

Egypt

Penetrating bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
KADAR	100 kg	54 kg HE	1.71 m	242 mm	base, impact, short delay	250 or 356 mm	in service	rocket assisted

France

General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
125 kg 81AF	125 kg	RDX/TNT	1.4 m (unfuzed)	206 mm	normally nose with 350 mm probe	356 mm	in service	can be fitted with ballistic or retard tail units
125 kg TLS	130 kg	PBXN-109	1.92 m (with MAU 94 tail)	229 mm	various	356 mm	in service	IM alternative for Mk 81
250 kg TLS	250 kg	PBXN-109	2.3 m (with BSU 33 tail)	273 mm	various	356 mm	in service	IM alternative for Mk 82
125 kg TMX	135 kg	PBXN-109	1.92 m (with MAU 94 tail)	239 mm	usually M904E3 nose, M905B or FMU 139A/B tail	356 mm	development complete	IM alternative for Mk 81
250 kg TMX	256 kg	PBXN-109	2.3 m (with BSU 33 tail)	283 mm	usually M904E3 nose, M905B or FMU 139A/B tail	356 mm	development complete	IM alternative for Mk 82
BANG 125	125 kg	33 kg IM HE fill	1.1 m	n/k	various	356 mm	in service	IM alternative for Mk 81
BANG 250	250 kg	70 kg IM HE fill	1.52 m	n/k	various	356 mm	in service	IM alternative for Mk 82
BL 5	50 kg	20 kg HE	1.31 m	176 mm	various 50 mm, nose/tail	356 mm	in service	
BL 6	118 kg	53 kg HE	1.78 m	228 mm	various 50 mm, nose/tail	356 mm	in service	
BL 7	115 kg	55 kg HE	1.66 m	228 mm	various 50 mm, nose/tail	356 mm	in service	can only be used with Italian SM-260 aircraft
BL 21-C	345 kg	HE	2.20 m	403 mm	various 50 mm, nose/tail	356 mm	in service	
BL 25	230 kg	123.5 kg HE	2.12 m	324 mm	various 50 mm, nose/tail	356 mm	in service	2 versions
BL EU2	230 kg	HE	2.167 m	273 mm	various 50 mm, nose/tail	356 mm	in service	with BS1 tail unit
BL EU3	452 kg	203 kg HE	2.86 m	356 mm	various 50 mm, nose/tail	356 mm	in service	with BS3 tail unit
BL EU4	1,000 kg	550 kg HE	3.8 m	457 mm	various 50 mm, nose/tail	356 mm	in service	with BS4 tail unit
BL EU4	1,000 kg	550 kg HE	3.22 m	457 mm	various 50 mm, nose/tail	356 mm	in service	with BSU-50/B tail retarder
LU 250 EG-FT	240 kg	87 kg HE	2.15 m	273 mm	various 50 mm, nose/tail	356 mm	in service	with conical tail unit
LU 250 EG-FT	254 kg	87 kg HE	2.16 m	273 mm	various 50 mm, nose/tail	356 mm	in service	with BSU-49/B tail unit
Mk 81	130 kg	[1]45 kg	1.92 m	229 mm	3.5 in nose/tail[2]	250 or 356 mm	in service	as US bomb
Mk 82	250 kg	[1]90 kg	2.3 m	273 mm	3.5 in nose/tail[2]	250 or 356 mm	in service	as US bomb
Mk 83	500 kg	[1]	3.03 m	356 mm	3.5 in nose/tail[2]	250 or 356 mm	in service	as US bomb
Mk 84	1,000 kg[1]		3.83 m	457 mm	3.5 in nose/tail[2]	650 or 762 mm	in service	as US bomb
Type 25	247 kg	123.5 kg	2.12 m	324 mm	n/k	356 mm	in service	
Type 200	345 kg	172.5 kg	2.2 m	403 mm	n/k	356 mm	in service	

Notes:
[1]TNT, Tritonal or H-6 explosive.
[2]3.5 in fuze wells can be reduced to 50 mm using an adaptor.

Fragmentation bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
125 kg Close support bomb	125 kg	n/k	n/k	n/k	n/k	356 mm	in service	uses FP 78 standoff nose probe
BAT 120	34 kg	6 kg HE in two warheads (see diagram)	1.5 m	120 mm	nose, impact	special carriers with 9 or 18 bombs	in service	fragmentation weapon with two warheads

France (continued)

Fragmentation bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BL 8	120 kg	20.4 kg HE	1.58 m	195 mm	various 50 mm, nose/tail	356 mm	in service	
BL 9	120 kg	20.4 kg HE	1.38 m	195 mm	various 50 mm, nose/tail	356 mm	in service	can only be used with Italian SM-260 aircraft
BL 18	125 kg	25 kg HE	1.81 m	195 mm	various 50 mm, nose/tail	356 mm	in service	
T 15 (BL 83)	15 kg	3 kg HE	0.75 m	119 mm	various 50 mm, nose/tail	special carrier	in service	
BL 25A	120 kg	HE	1.53 m	219 mm	various 50 mm, nose/tail	356 mm	in service	with BS 19 tail unit
BL 61	125 kg	HE	1.33 m	219 mm	various 50 mm, nose/tail	356 mm	in service	with BS 19 tail unit
BL 70	400 kg	HE	2.09 m	324 mm	various 50 mm, nose/tail	356 mm	in service	with 25F tail unit
BL EU2FR	270 kg	HE	2.07 m	273 mm	various 50 mm, nose/tail	356 mm	in service	with BSU-86/ B tail unit

Penetrating bombs

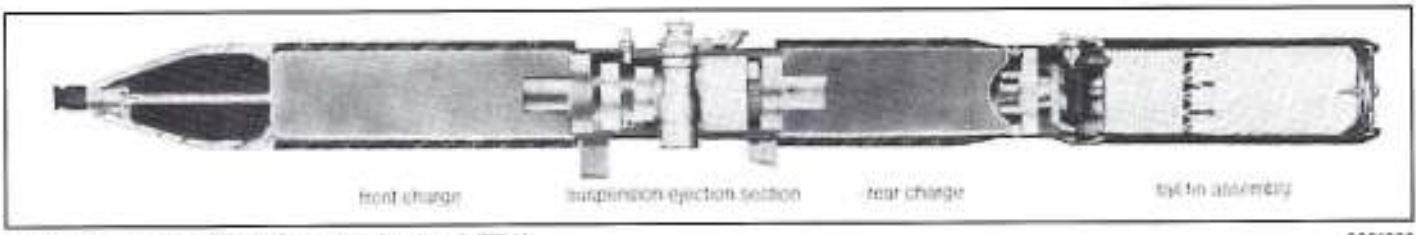
Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BL 104	433 or 441 kg	PBXN-109	2.9 m	298 mm	tail, MFBF 960	356 mm	in service	with 25E2/A tail unit
BL 105	897 kg	PBXN-109	3.9 m	356 mm	tail, MFBF 960	762 mm	in service	with B53
BL 108	125 kg	PBXN-109	1.64 m (with BS 19 tail)	230 mm	tail, MFBF 960	356 mm	in service	tail unit
BAP 100	32.5 kg	3.5 kg HE	1.78 m	100 mm	short or long delay (up to 6 h)	special carriers with 9 or 18 bombs	in service	
BL EU 2P	232 kg	HE	2.24 m	273 mm	various tail	356 mm	in service	
Durandal	185 kg	15 kg HE	2.49 m	223 mm	short or long delay (up to 6 h)	356 mm	in service	
SAMP I-500	256 kg	46.5 kg *Note 3*	1.58 m	218 mm	3.5 in tail	356 mm	entering service	
SAMP BLU-109	867 kg	*Note 3*	2.51 m	368 mm	3.5 in tail	762 mm	in service	

Note 3: TNT, Tritonal, H-6 or PBX explosive.

Guided bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
250 kg LGB	250 kg	HE	3.61 m	324 mm	n/k	356 mm	in service	
400 kg GP LGB	470 kg	HE	3.54 m	403 mm	n/k	356 mm	in service	
400 kg PE LGB	450 kg	HE	3.64 m	391 mm	n/k	356 mm	in service	

A sectioned French BAP 100 airfield cratering bomb (TDA) 0001984



A sectioned French BAT 120 fragmentation bomb (TDA) 0001986

France (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
1,000 kg LGB Arcole	970 kg	HE	4.37 m	457 mm	n/k	356 mm	in service	
AASM 250	340 kg	HE	3.0 m	273 mm	impact or delay	356 mm	in service	one of a family of bombs using a GPS/INS guidance kit on a conventional bomb body

A French BL 70 fragmentation bomb fitted with M904 nose fuze and M905 tail fuze. Note the external vanes of the M905 fuze on the side of the tail unit (SAMP)
0051998

1,000 and 400 kg LGBs (TDA)
0051995

Greece

General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
Mk 81	117.5 kg	45 kg HE	1.94 m	225 mm	*Note 1*	356 mm	in service	*Note 2*
Mk 82	241 kg	87 kg HE	2.2 m	273 mm	*Note 1*	356 mm	in service	*Note 2*
Mk 83	447 kg	202 kg HE	3 m	356 mm	*Note 1*	356 mm	in service	*Note 2*
Mk 84	894 kg	429 kg HE	3.85 m	457 mm	*Note 1*	762 mm	in service	*Note 2*

Note 1: Various nose and tail fuzes, including proximity.
Note 2: Based on US Mk 80 series bombs; can be fitted with retard tail units and precision guidance units.

Mk 81 (below) and Mk 82 (above) with PF 201 nose fuzes (Ordtech)
0100981

Iraq

General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BADR-28	500 kg	RDX/TNT/Al	2.42 m	400 mm	n/k	250 mm	in service	
FARIS-250	250 kg	RDX/TNT/Al	1.92 m	300 mm	n/k	250 mm	in service	
KAAKAA-500	500 kg	TNT	1.58 m	450 mm	n/k	250 mm	in service	
NASR-7	500 kg	TNT	2.42 m	400 mm	nose/tail, type n/k	250 mm	in service	high-drag Russian design
NASR-28	880 kg	TNT	3.73 m	457 mm	nose/tail, type n/k	n/k	in service	high-drag Russian design
NASR-250	250 kg	TNT	2.12 m	324 mm	nose/tail, type n/k	356 mm	in service	similar to US Mk 82 bomb
NASR-400	400 kg	TNT	2.19 m	406 mm	nose/tail, type n/k	356 mm	in service	low drag with triform tail
NASR-1500	1,500 kg	TNT	3.32 m	630 mm	nose/tail, type n/k	n/k	in service	similar to Chinese Type 2
NASR-3000	3,000 kg	TNT	3.32 m	820 mm	nose/tail, type n/k	n/k	in service	similar to Chinese Type 2
NASR-5000	5,000 kg	TNT	3.32 m	1,060 mm	nose/tail, type n/k	n/k	in service	high-drag Russian design
NASR-9000	9,000 kg	TNT	5.0 m	1,200 mm	nose/tail, type n/k	n/k	in service	high-drag Russian design

Fragmentation bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
KAAKAA-120	120 kg	TNT	1.06 m	270 mm	nose/tail, type n/k	single	in service	
KAAKAA-250	250 kg	TNT	1.514 m	325 mm	nose/tail, type n/k	250 mm	in service	
KAAKAA-500	500 kg	TNT	1.4 m	450 mm	nose/tail, type n/k	250 mm	in service	similar in size and shape to Chinese 500 kg Type 2

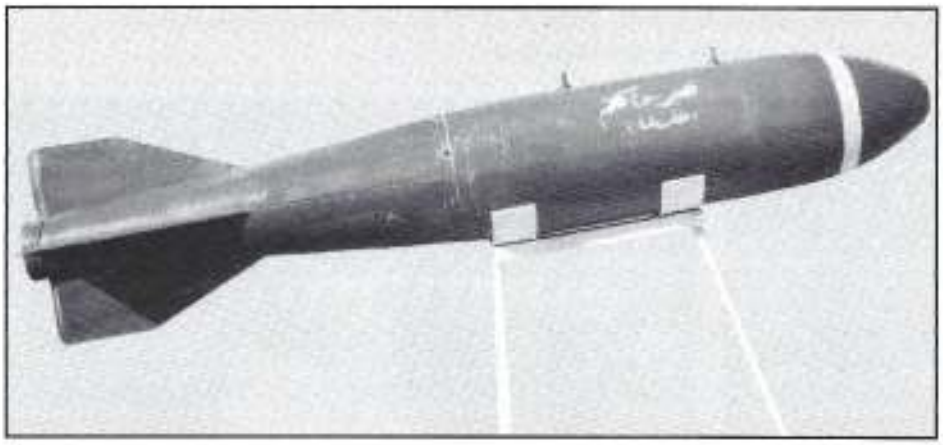
Penetrating bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
NASR-500P	500 kg	TNT	n/k	n/k	tail, type n/k	n/k	in service	similar to French design

KAAKAA 250 kg fragmentation bomb
0504514

Iraq (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
NASR-1000P	1,000 kg	TNT	3.38 m	457 mm	tail, type n/k	356 mm	in service	similar to French BL EU4



NASR 250 kg GP bomb
0504518

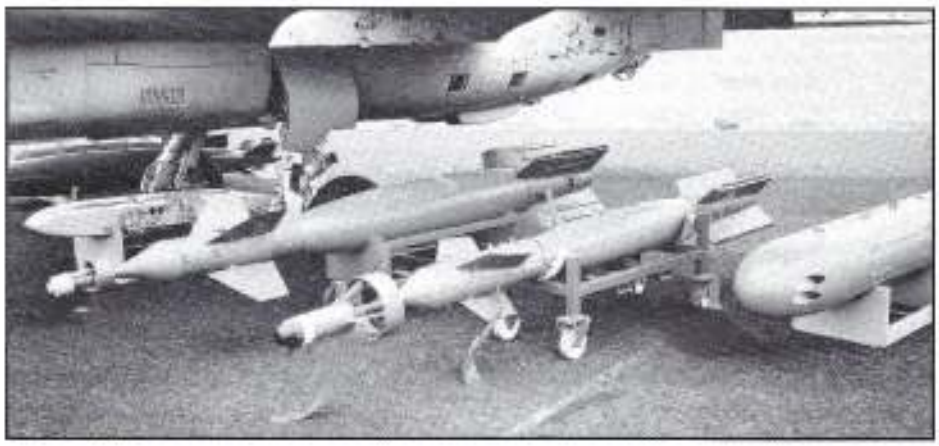
Israel

Penetrating bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
Condib 70	70 kg	n/k	n/k	n/k	tail, short delay	356 mm	in service	
Condib 120	120 kg	n/k	n/k	n/k	tail, short delay	356 mm	in service	
PB-500AI	425 kg	100 kg HE	1.8 m	269 mm	tail, short delay	356 mm	in service	dimensions exclude tail. Similar to US Mk 83

Guided bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
Opher	325 kg	87 kg HE	3.43 m	273 mm	n/k	356 mm	in service	used with Mk 82 bomb body



Centre: an Israeli Opher guidance kit fitted to a Mk 82 bomb. To the left is a US Paveway II LGB
(Peter Humphris) 0106154

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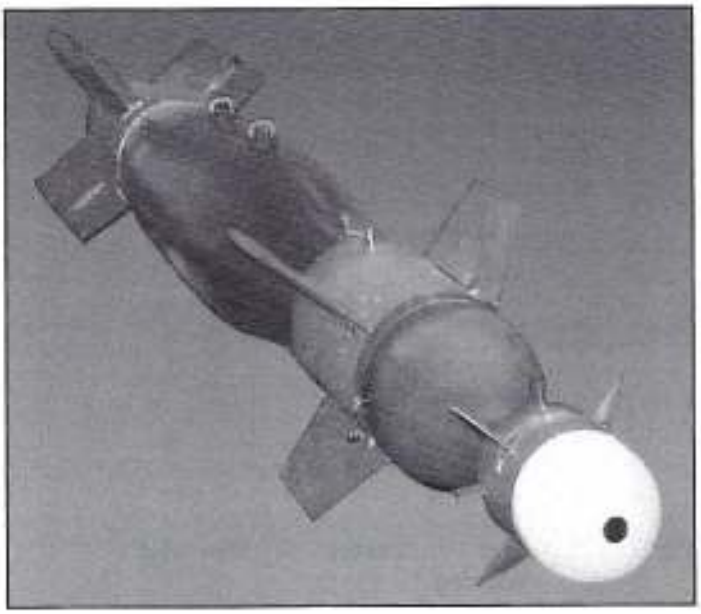
Israel (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
Pyramid	363 kg	87 kg HE	2.0 m	273 mm	nose/tail, types n/k	356 mm	in service	TV guided. Used with Mk 82 bomb body

Notes:
'Griffin' and 'Guillotine' are in-service terminal guidance kits for use with Mk 82, 83 and 84 bombs.
'Lizard' is a range of 4 modular guidance kits designed for use with general-purpose and penetrating bombs.
'Spice' is a wing and guidance kit for Mk 84 bombs, currently in development.



An Israeli PB-500Al penetration bomb fitted with laser guidance unit (Duncan Lennox) 0022899

The Lizard 3 guidance kit has a distinctive seeker head (Elbit) 0130542

Italy

General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
SEI BA 102	227 kg	*Note 1*	2.17 m	273 mm	nose/tail, various	356 mm	in service	*Note 2*
SEI BA 103	454 kg	*Note 1*	2.89 m	356 mm	nose/tail, various	356 mm	in service	*Note 2*
SEI BA 104	908 kg	*Note 1*	3.72 m	457 mm	nose/tail, various	762 mm	in service	*Note 2*

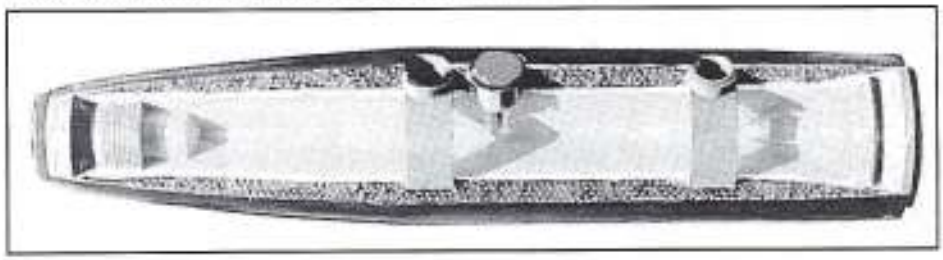
Note 1: Filling may be TNT, Tritonal or H-6 explosive.
Note 2: Bombs are based on the US Mk 80 series and can be fitted with laser guidance units. They may also be referred to as SEI 227 kg, SEI 454 kg and SEI 908 kg.

Pakistan

General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
Mk P8 227 kg	241 kg	87 kg RDX/TNT	2.21 m	273 mm	nose/tail, impact or short delay	356 mm	in service	identical to US Mk 82 bomb; see *Note 2*
Mk 81	130 kg	45 kg HE	1.92 m	229 mm	*Note 1*	250 or 356 mm	in service	*Note 2*
Mk 82	250 kg	90 kg HE	2.2 m	273 mm	*Note 1*	250 or 356 mm	in service	*Note 2*
Mk 83	500 kg	200 kg HE	3.03 m	356 mm	*Note 1*	250 or 356 mm	in service	*Note 2*
Mk 84	1,000 kg	425 kg HE	3.83 m	457 mm	*Note 1*	650 or 762 mm	in service	*Note 2*

Note 1: Various nose and tail fuzes, including proximity.
Note 2: Based on US Mk 80 series bombs; can be fitted with retard tail units and Paveway laser-guidance systems.



Cutaway of a Mk 82 fragmentation bomb (AWC) 0006374

Pakistan (continued)

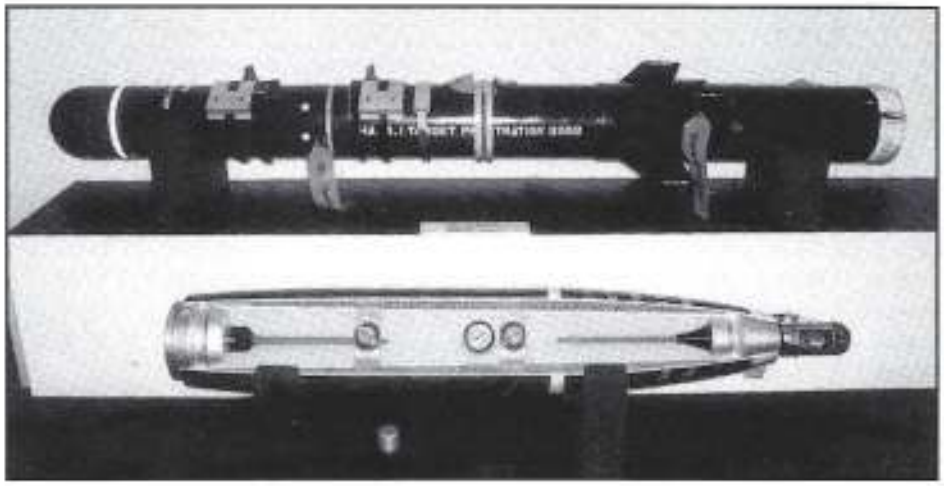
Fragmentation bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
Mk 81 fragmentation	125 kg	23 kg HE and steel balls	1.25 m	228 mm	nose, proximity	356 mm	in service	Approx 19,000 fragments; *see Note 1*
Mk 82 fragmentation	250 kg	50 kg HE and steel balls	2.2 m	273 mm	nose, proximity	356 mm	in service	Approx 37,000 fragments; *see Note 1*

Note 1: Fibre composite bodies filled with steel ball bearings. May be fitted with retard tail units.

Penetrating bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
HAFR-1	n/k	100 kg HE	2.48 m	223 mm	short delay	356 mm	in service	anti-runway weapon similar to 'Durandal'



Pakistan HAFR-1 penetration bomb (top) with cutaway 250 kg fragmentation bomb (below) (Paul Jackson)
0100150

Portugal

General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
AA GP 50/2	59 kg	26 kg HE	n/k	n/k	nose/tail, various	356 mm	in service	
AA GP 100/2	114 kg	56 kg HE	n/k	n/k	nose/tail, various	356 mm	in service	
AA GP 250/2	254 kg	112 kg HE	n/k	n/k	nose/tail, various	356 mm	in service	
AA GP 300/2	326 kg	177 kg HE	n/k	n/k	nose/tail, various	356 mm	in service	
AA GP 400/2	356 kg	164 kg HE	n/k	n/k	nose/tail, various	356 mm	in service	
AA GP 500/1	481 kg	243 kg HE	n/k	n/k	nose/tail, various	356 or 762 mm	in service	
AA/GP/LD 125/1	120 kg	45 kg HE	1.88 m	228 mm	nose/tail, various	356 mm	in service	based on US Mk 81
AA/GP/LD 250/1	235 kg	87 kg HE	2.21 m	273 mm	nose/tail, various	356 mm	in service	based on US Mk 82
AA/GP/LD 500/1	447 kg	185 kg HE	3.0 m	350 mm	nose/tail, various	356 or 762 mm	in service	based on US Mk 83
AA/GP/LD 1000/1	894 kg	429 kg HE	3.38 m	460 mm	nose/tail, various	762 mm	in service	based on US Mk 84

Fragmentation bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
AA FR 15	15 kg	3 kg HE	n/k	n/k	nose/tail, various	356 mm	in service	thick steel case

Portugal (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
AA FR 50	50 kg	7 kg HE	n/k	n/k	nose/tail, various	356 mm	in service	thick steel case
AA FR 200	200 kg	40 kg HE	n/k	n/k	nose/tail, various	356 mm	in service	thick steel case
AA LC 300/1	290 kg	215 kg	n/k	n/k	nose/tail, various	356 mm	in service	thin skinned case
AA LC 500/1	490 kg	360 kg	n/k	n/k	nose/tail, various	356 or 762 mm	in service	thin skinned case

Russian Federation

See diagrams in separate entry: 'Russian Federation Bombs'.

General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
FAB-50 (welded)	60.3 kg	HE	0.95 m	241 mm	n/k	n/k	in service	
FAB-50 (forged)	50 kg	HE	0.94 m	238 mm	n/k	n/k	in service	
FAB-70 (body only)	69.8 kg	HE	0.81 m	241 mm	n/k	n/k	in service	
FAB-250 (welded)	249 kg	HE	2.16 m	320 mm	n/k	250 mm	in service	
FAB-250 (forged)	238 kg	HE	1.82 m	325 mm	n/k	250 mm	in service	
FAB-500	506 kg	HE	2.41 m	447 mm	n/k	250 mm	in service	
FAB-100 M43	103 kg	32 kg HE	1.06 m	269 mm	*Note 1*	250 mm	in service	
FAB-250 M43	237 kg	114 kg HE	2.16 m	320 mm	*Note 1*	250 mm	in service	
FAB-250 M46	220 kg	102 kg HE	1.5 m	320 mm	*Note 1*	250 mm	in service	
FAB-500 M46	429 kg	206 kg HE	1.5 m	417 mm	*Note 1*	250 mm	in service	
FAB-1500 M46	1,347 kg	658 kg HE	2.8 m	622 mm	*Note 1*	n/k	in service	
FAB-3000 M46	2,983 kg	1,465 kg HE	3.38 m	850 mm	*Note 1*	n/k	in service	
FAB-250 M54	234 kg	94 kg HE	1.49 m	320 mm	*Note 1*	250 mm	in service	
FAB-500 M54	474 kg	201 kg HE	1.5 m	450 mm	*Note 1*	250 mm	in service	
FAB-1500 M54	1,392 kg	667 kg HE	2.31 m	570 mm	*Note 1*	n/k	in service	
FAB-100 M62	99.8 kg	44.9 kg torpex	1.69 m	216 mm	*Note 1*	250 mm	in service	
FAB-250 M62	250 kg	113 kg torpex	2.26 m	292 mm	*Note 1*	250 mm	in service	
FAB-500 M62	497 kg	214 kg torpex	2.43 m	400 mm	*Note 1*	250 mm	in service	
FAB-1000 M62	1,033 kg	476 kg torpex	3.56 m	498 mm	*Note 1*	n/k	in service	
FAB-250ShN	275 kg	HE	1.99 m	325 mm	nose, various	250 mm	in service	parachute retarded
FAB-250TS	259 kg	HE	1.50 m	300 mm	n/k	250 mm	in service	thick-cased, low-drag
FAB-500ShN	513 kg	218 kg HE	2.19 m	450 mm	nose, various	250 mm	in service	parachute retarded
FAB-500T	517 kg	194 kg HE	2.47 m	400 mm	various nose and tail	250 mm	in service	low-drag

Note 1: Generally use impact nose fuzes from the VDU and APUV range, but may accept more modern fuzes.

Fragmentation bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
AO-8M2	7.4 kg	0.9 kg HE	0.48 m	104 mm	n/k	single	*Note 2*	
AO-10	9.53 kg	0.86 kg HE	0.48 m	91.5 mm	n/k	single	*Note 2*	
AO-10-6.5	6.48 kg	0.68 kg HE	0.46 m	76.3 mm	n/k	single	*Note 2*	
AO-20	21.3 kg	3.0 kg HE	0.76 m	114 mm	n/k	single	*Note 2*	
AO-20M3	21 kg	3.0 kg HE	0.98 m	119 mm	n/k	single	*Note 2*	
A0-25M1	23.6 kg	3.6 kg HE	1.06 m	122 mm	n/k	single	*Note 2*	
AO-25M2	24.5 kg	3.8 kg HE	1.08 m	122 mm	n/k	single	*Note 2*	
AO-100	99.8 kg	49.9 kg HE	1.09 m	282 mm	n/k	single	*Note 2*	
OFAB-100M	136 kg	45.4 kg HE	1.07 m	279 mm	n/k	single	in service	*Note 3*
OFAB-100MH	145 kg	45.4 kg HE	1.19 m	279 mm	n/k	single	in service	*Note 3*
OFAB-100NV	113 kg	HE	1.07 m	279 mm	n/k	single	in service	*Note 3*
OFAB-100-120	123 kg	42 kg HE	1.065 m	273 mm	n/k	single	in service	*Note 3*
OFAB-250-270	275 kg	94 kg HE	1.456 m	325 mm	n/k	250 mm	in service	*Note 3*
OFAB-250M	268 kg	88 kg HE	3.0 m	325 mm	nose, probe	250 mm	in service	length includes 1.5 m probe

Russian Federation (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
OFAB-250ShL	268 kg	94 kg HE	1.99 m	325 mm	nose/tail, various	250 mm	in service	mechanically retarded
OFAB-250ShN	275 kg	95.7 kg HE	1.99 m	325 mm	nose/tail, various	250 mm	in service	parachute retarded
OFAB-250T	275 kg	95.7 kg HE	2.05 m	300 mm	n/k	250 mm	in service	low-drag, pre-fragmented body
OFAB-500ShR	497 kg	126 kg HE	2.94 m	450 mm	n/k	250 mm	in service	contains multiple warheads
OFAB-500U	515 kg	155 kg HE	2.3 m	400 mm	nose/tail, various	250 mm	in service	parachute retarded

Note 2: Some may remain in service, but most are obsolete.
Note 3: Can be fitted with parachute retard systems.

Penetrating bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BetAB-150DS	165 kg	16 kg HE	2.1 m	203 mm	tail, short delay	250 mm	in service	
BetAB-250	250 kg	HE	n/k	n/k	tail, short delay	250 mm	in service	
BetAB-500	478 kg	75.8 kg HE	2.2 m	350 mm	tail, short delay	250 mm	in service	
BetAB-500ShP	380 kg	77 kg HE	2.51 m	325 mm	tail, short delay	250 mm	in service	rocket-assisted
BetAB-500U	510 kg	45 kg HE	2.48 m	450 mm	tail, short delay	250 mm	in service	rocket-assisted
BRAB-200DS	213 kg	12.2 kg HE	2.06 m	203 mm	n/k	250 mm	in service	armour-piercing
BRAB-220	238 kg	38 kg HE	1.68 m	277 mm	n/k	250 mm	in service	armour-piercing
BRAB-500	500 kg	106 kg HE	2.36 m	399 mm	n/k	250 mm	in service	armour-piercing
BRAB-1000	963 kg	207 kg HE	3.08 m	480 mm	n/k	n/k	in service	armour-piercing
FZAB-500	500 kg	200 kg Torpex HE plus incendiary material	2.5 m	450 mm	tail, short delay	250 mm	in service	concrete-piercing HEI bomb

Guided bombs

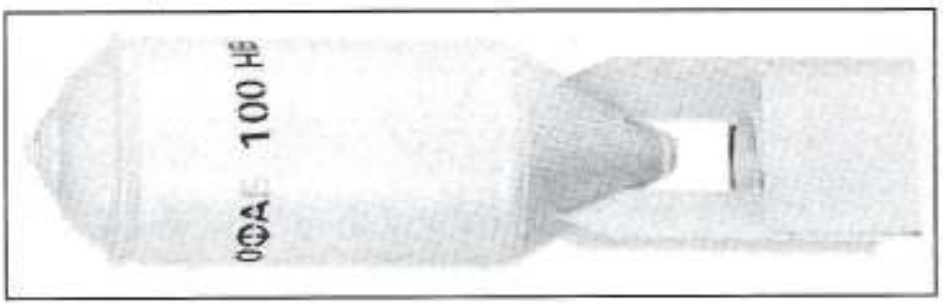
Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
KAB-500Kr	525 kg	195 kg HE	3.05 m	350 mm	*Note 4*	250 mm	in service	Electro-optic guidance

A Russian KAB-1500L laser-guided bomb with rear wings folded (Paul Jackson) 0051983

Russian Federation (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
KAB-500Kr-OD	525 kg	385 kg warhead with 280 kg FAE	3.05 m	350 mm	likely to be airburst proximity	250 mm	in service	Electro-optic guidance
KAB-500Kr-E	520 kg	380 kg penetration warhead with 100 kg HE	3.05 m	350 mm	impact or delay	250 mm	in service	Electro-optic guidance
KAB-500L	534 kg	195 kg HE	3.05 m	400 mm	*Note 4*	250 mm	in service	laser guided
KAB-500LG	560 kg	195 kg HE	2.75 m	400 mm	*Note 4*	250 mm	believed to be in service	Gyro-stabilised laser seeker
KAB-500S, KAB-500S-E	560 kg	380 kg warhead	3.0 m	350–400 mm	impact or delay	250 mm	believed to be in service	GPS guidance. Offered for export
KAB-1500L-F	1,560 kg	440 kg HE	4.6 m	580 mm	*Note 4*	250 mm	in service	laser guided warhead is HE blast
KAB-1500Kr	1,525 kg	1,170 kg warhead with 440 kg HE	4.63 m	580 mm	impact or delay	250 mm	in service	Electro-optic guidance. Exported to China and India
KAB-1500Kr–Pr	1,525 kg	1,100 kg penetrator warhead with 210 kg HE	4.63 m	580 mm	impact or delay	250 mm	in development	Electro-optic guidance
KAB-1500Kr-OD	1,525 kg	1,170 kg warhead with 650 kg FAE	4.63 m	580 mm	likely to be airburst proximity	250 mm	in development	Electro-optic guidance
KAB-1500LG–FE	1,525 kg	1,170 kg warhead with 440 kg HE	4.58 m	580 mm	impact or delay	250 mm	in development	laser guided
KAB-1500LG–Pr-E	1,525 kg	1,100 kg penetrator warhead with 210 kg HE	4.58 m	580 mm	impact or delay	250 mm	in development	laser guided
KAB-1500LG-OD-E	1,525 kg	1,170 kg warhead with 650 kg FAE	4.58 m	580 mm	likely to be airburst proximity	250 mm	in development	laser guided
KAB-1500L-Pr	1,500 kg	1,100 kg HE	4.6 m	580 mm	*Note 4*	250 mm	in service	laser guided warhead is HE penetration

Note 4: Likely to be tail-fuzed, short delay.



A Bulgarian-built OFAB-100NV fragmentation bomb
0006385

Serbia

General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
FAB-100 (M80)	117 kg	39 kg TNT	1.49 m	230 mm	AVU-E or AUF-K	250 or 356 mm	in service	low drag (see Note)
FAB-250 (M79)	240 kg	105 kg TNT	2.01 m	325 mm	AVU-E or AUF-K	250 or 356 mm	in service	low drag (see Note)

Serbia (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
FAB-500	506 kg	HE	2.41 m	447 mm	n/k	n/k	in service	believed to be imported Russian bomb

Note: These bombs are similar to old Russian designs (see *Russian Federation bombs*) with cylindrical high-drag bodies. FAB-100 and 250 can also be fitted with UKB-100 retard tail units.

Fragmentation bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
FAB-250 (M72)	231 kg	96 kg TNT	1.46 m	325 mm	AVE or VDM	250 or 356 mm	in service	medium drag
RAB-120	120 kg	n/k	n/k	n/k	nose/tail; AVE or VDM	356 mm	in service	

Singapore

General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
250 kg	241 kg	85 kg TNT or Tritonal	2.2 m	270 mm	nose/tail, various	356 mm	in service	based on US Mk 82

South Africa

General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
12.5 kg (practice bomb)	12.5 kg	0.95 kg pyrotechnic charge	0.765 m	95 mm		n/k	in service	simulates 480 kg GP bomb
120 kg	115 kg	47 kg RDX/TNT	n/k	n/k	*Note 1*	250 or 356 mm	in service	similar to US Mk 81
250 kg	228 kg	103 kg HE	n/k	n/k	*Note 1*	250 or 356 mm	in service	similar to US Mk 82
250 kg (practice bomb)	228 kg	steel balls	n/k	n/k		250 or 356 mm	in service	
480 kg	466 kg	228 kg Torpex	n/k	n/k	*Note 1*	250 or 356 mm	in service	similar to US Mk 83

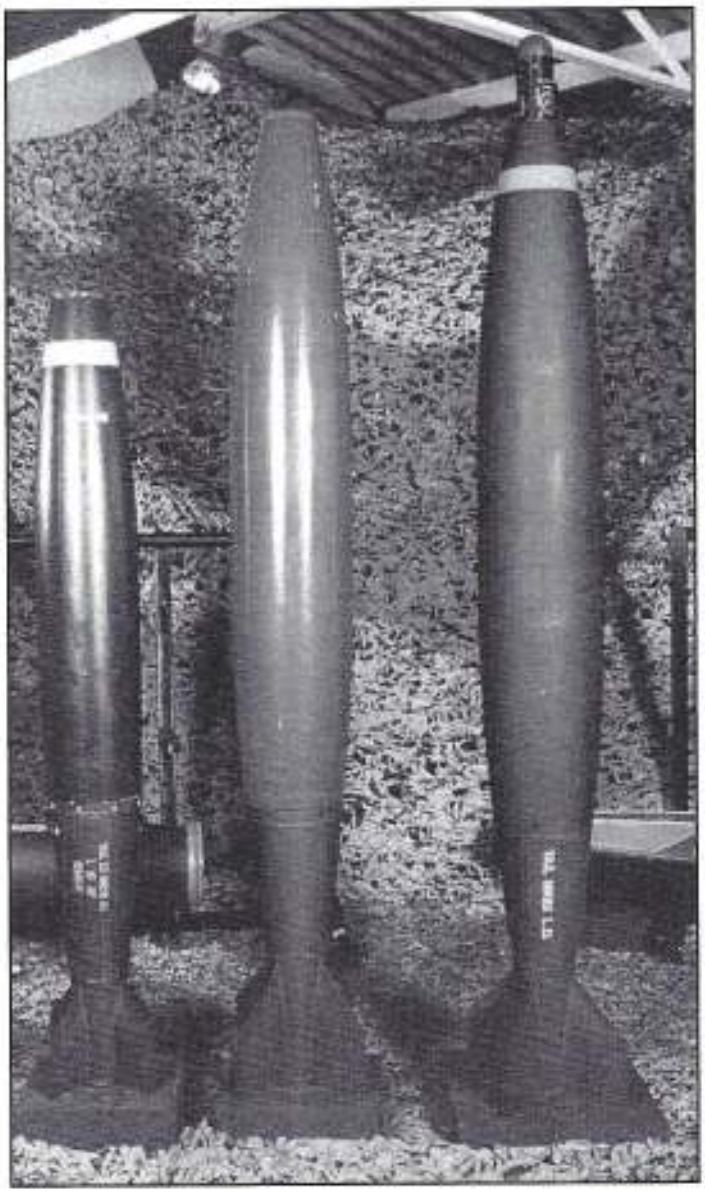
Note 1: Standard fuzes are SA 771 (nose) and SA 772 (tail); both are mechanical impact/variable short delay fuzes.

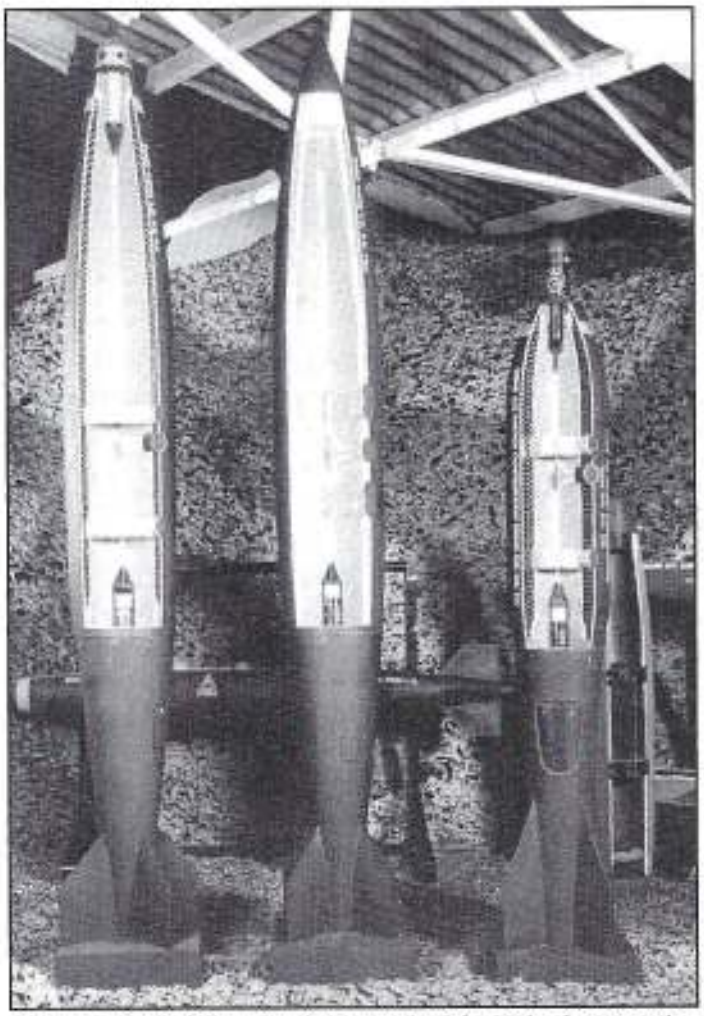
Fragmentation bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
120 kg	122 kg	27 kg HE and steel balls	n/k	n/k	*Note 1*	250 or 356 mm	in service	
Mk 81	122 kg	27 kg HE and carbon steel balls	1.78 m	230 mm	*Note 2*	250 or 356 mm	in service	specially constructed glass fibre body
Mk 82	226 kg	48 kg HE and carbon steel balls	2.16 m	273 mm	*Note 2*	250 or 356 mm	in service	specially constructed glass fibre body
Mk 83	415 kg	70 kg HE and carbon steel balls	2.86 m	355 mm	*Note 2*	250 or 356 mm	in service	specially constructed glass fibre body

Note 1: Standard fuzes are SA 771 (nose) and SA 772 (tail); both are mechanical impact/variable short delay fuzes.
Note 2: Normally nose fuzed. Standard 51 mm wells will accept a variety of fuzes, including proximity.

South Africa (continued)





Sectioned South African bombs. From the left: 440 kg fragmentation, 440 kg penetration and 400 kg fragmentation (Reunert) 0006397

South African bombs. From the left: 120 kg fragmentation, 250 kg practice and 250 kg fragmentation
(Reunert)
0006396

Guided bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BARB	450 kg	87 kg HE	n/k	273 mm	n/k	250 or 356 mm	in development	passive radar guided Mk 82 bomb
Raptor 1	980 kg	428 kg HE	3.65 m	380 mm	n/k	762 mm	entering service	

Spain

General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
ALD-50	57 kg	24 kg HE	1.38 m	178 mm	*Note 1*	250 or 356 mm	in service	
ALD-125	120 kg	57 kg HE	1.81 m	236 mm	*Note 1*	250 or 356 mm	in service	
ALD-250	245 kg	95 kg HE	2.15 m	290 mm	*Note 1*	250 or 356 mm	in service	
ALD-500	450 kg	210 kg HE	2.75 m	360 mm	*Note 1*	250 or 356 mm	in service	
ASH-250	262 kg	97 kg HE	2.15 m	290 mm	*Note 2*	250 or 356 mm	in service	retarded
ASH-500	470 kg	210 kg HE	2.75 m	360 mm	*Note 2*	250 or 356 mm	in service	retarded
BR 50	50 kg	20 kg HE	1.4 m	180 mm	*Note 3*	250 or 356 mm or single	in service	*Note 4*
BR 125	125 kg	55 kg HE	1.82 m	240 mm	*Note 3*	250 or 356 mm or single	in service	*Note 4*
BR 250	250 kg	112 kg HE	2.15 m	290 mm	*Note 3*	250 or 356 mm or single	in service	*Note 4*

Spain (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BR 375	375 kg	170 kg HE	2.8 m	330 mm	*Note 3*	250 or 356 mm or single	in service	*Note 4*
BR 500	500 kg	206 kg HE	2.94 m	360 mm	*Note 3*	250 or 356 mm or single	in service	*Note 4*
BR 1000	1,000 kg	475 kg HE	3.82 m	460 mm	*Note 3*	762 mm	in service	*Note 4*
BRP 50	50 kg	20 kg HE	1.42 m	180 mm	*Note 5*	250 or 356 mm or single	in service	retarded *Note 4*
BRP 125	125 kg	HE	1.82 m	240 mm	*Note 5*	250 or 356 mm or single	in service	retarded *Note 4*
BRP 250	250 kg	112 kg HE	2.28 m	290 mm	*Note 5*	250 or 356 mm or single	in service	retarded *Note 4*
BRP 375	375 kg	170 kg HE	2.85 m	330 mm	*Note 5*	250 or 356 mm or single	in service	retarded *Note 4*
BRP 500	500 kg	206 kg HE	3.0 m	360 mm	*Note 5*	250 or 356 mm or single	in service	retarded *Note 4*
BRPS 125	125 kg	HE	1.87 m	240 mm	*Note 5*	250 or 356 mm or single	in service	retarded
BRPS 250	250 kg	112 kg HE	2.15 m	290 mm	*Note 5*	250 or 356 mm or single	in service	retarded
BRPS 500	500 kg	206 kg HE	2.85 m	260 mm	*Note 5*	250 or 356 mm or single	in service	retarded

Note 1: Various nose and tail fuze options, including delay and proximity.
Note 2: Nose-mounted electronic time fuze (TF-4000E) and mechanical impact tail fuze (TF-5000).
Note 3: GP versions use MU 5 or MU 9 nose fuzes and MU 8 tail fuze. Fragmentation versions may use VTE 60 proximity fuze.
Note 4: Based on US Mk 80 series. HE may be TNT, Tritonal or H-6.
Note 5: Various nose and side-mounted fuze options, including the GRT long delay and the GAMMA all-ways acting fuzes.

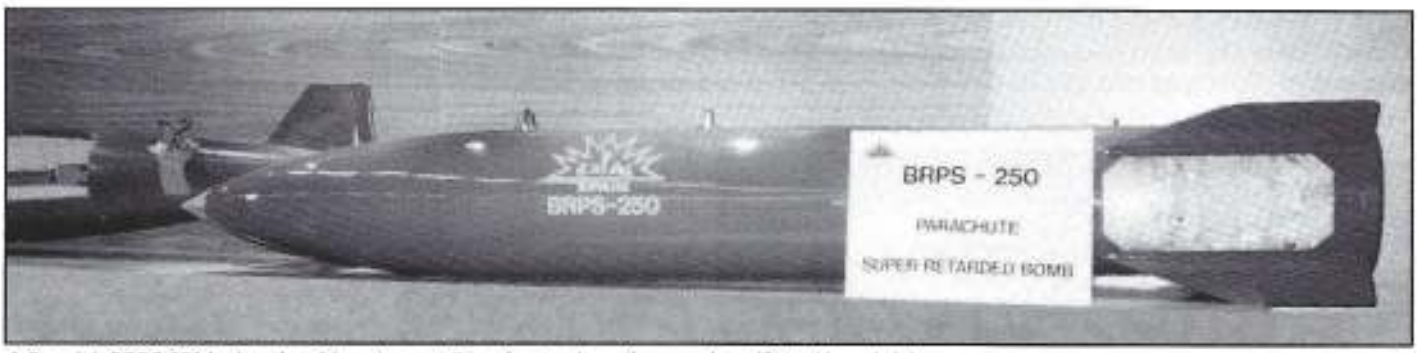
Fragmentation bombs

With the exception of the ASH-250 and 500, there are fragmentation versions of all of the above GP bombs.

Penetrating bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BPG-2000	917 kg	243 kg	4.75 m (fuzed)	368 mm	tail, short delay	762 mm	in service	*Note 1*
BRFA 330	330 kg	75 kg	3.0 m	300 mm	tail, short delay	250 or 356 mm	in service	rocket-assisted
GB-2000	930 kg	227 kg	4.12 m	368 mm	tail, short delay	762 mm	in service	*Note 1*

Note 1: Similar to the US 2,000 lb BLU-109. Can be fitted with guidance kits, such as Paveway III.



A Spanish BRPS 250 kg bomb, with cutaway tail section to show the parachute (Peter Humphris) 0062836

ASH-500 parachute-retarded GP bomb 0504580

Sweden

General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
M50 Type SB	250 kg	90 kg HE	2.2 m	270 mm	n/k	356 or 762 mm	uncertain	*see Notes*
M50 Type MB	600 kg	n/k	n/k	n/k	n/k	356 or 762 mm	uncertain	*see Notes*
M51 Type SB	120 kg	45 kg HE	1.9 m	230 mm	n/k	356 or 762 mm	uncertain	*see Notes*
M56 Type MB	500 kg	200 kg HE	3 m	350 mm	n/k	356 or 762 mm	uncertain	*see Notes*

Note: Based on the US Mk 80 series; construction and specifications are likely to be similar to the US bombs. Dimensions and explosive weights are estimates only.

Fragmentation bombs

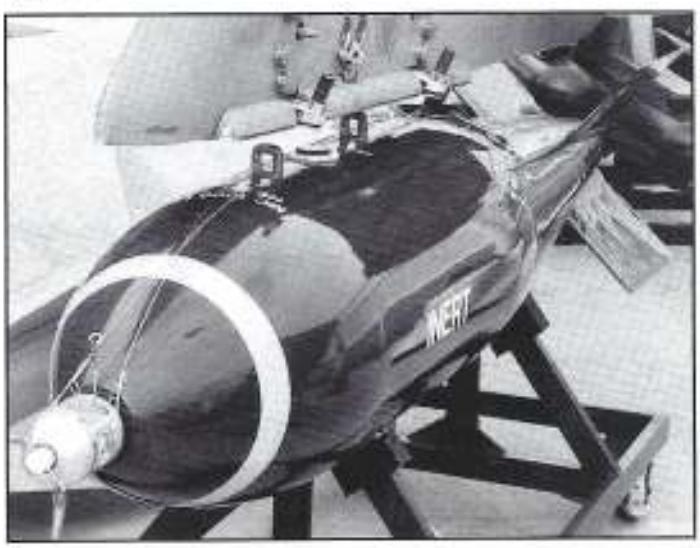
Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
M60 Type LYSB	80 kg	n/k	n/k	n/k	n/k	356 or 762 mm	uncertain	
M 71 Virgo	123 kg	30 kg RDX/TNT and steel fragments	1.9 m with nose probe. 1.62 m with normal fuze	214 mm		single lug	in service	retarded bomb

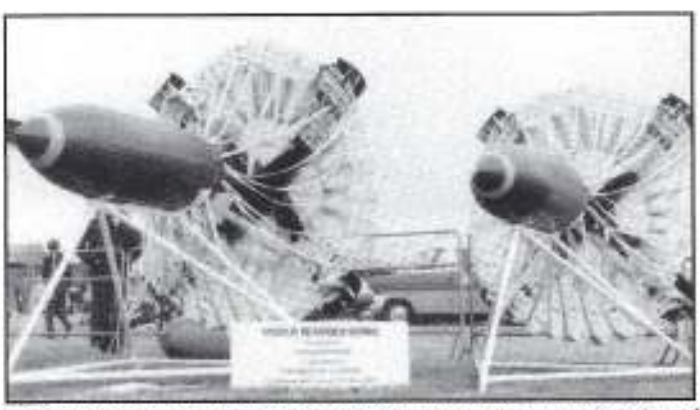
United Kingdom

General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
227 kg Mk 1	260.6 kg	97 kg RWA 4	2.0 m	330 mm	*Note 1*	356 mm or single	in service	with No 116 ballistic tail
227 kg Mk 2	259.6 kg	97 kg Torpex	2.0 m	330 mm	*Note 1*	356 mm or single	in service	with No 116 ballistic tail
227 kg Mk 1	296 kg	97 kg RWA 4	2.0 m	330 mm	*Note 1*	356 mm or single	in service	with No 118 retard tail
227 kg Mk 2	295 kg	97 kg Torpex	2.0 m	330 mm	*Note 1*	356 mm or single	in service	with No 118 retard tail
454 kg Mk 10	405 kg	180 kg Torpex	1.26 m	420 mm	*Note 1*	356 mm or single	in service	without tail unit
454 kg Mk 13	412 kg	180 kg RWA 4	1.26 m	420 mm	*Note 1*	356 mm or single	in service	without tail unit; *see Note 2*
454 kg Mk 18	412 kg	180 kg Torpex	1.26 m	420 mm	*Note 1*	356 mm or single	in service	without tail unit; *see Note 2*
454 kg Mk 20	410 kg	184 kg Torpex	1.26 m	420 mm	*Note 1*	356 mm or single	in service	without tail unit; *see Note 2*

Note 1: Various nose and tail fuzes can be used, including the electronic Multi-Function Bomb Fuze (MFBF 960).
Note 2: 'Paveway' laser guidance systems can be fitted to these bombs.
General: All 454 kg bombs can be fitted with Type 117 retard tail units; Type 118 retard tail units can be fitted to 227 kg bombs.





Type 117 retard tail units fitted to Mk 20 bombs; note the combination of four paddles and a parachute (Hunting Engineering) 0006402

An inert British Mk 20 bomb fitted with an FEU-80 fuze (Duncan Lennox) 0006399

United Kingdom (continued)

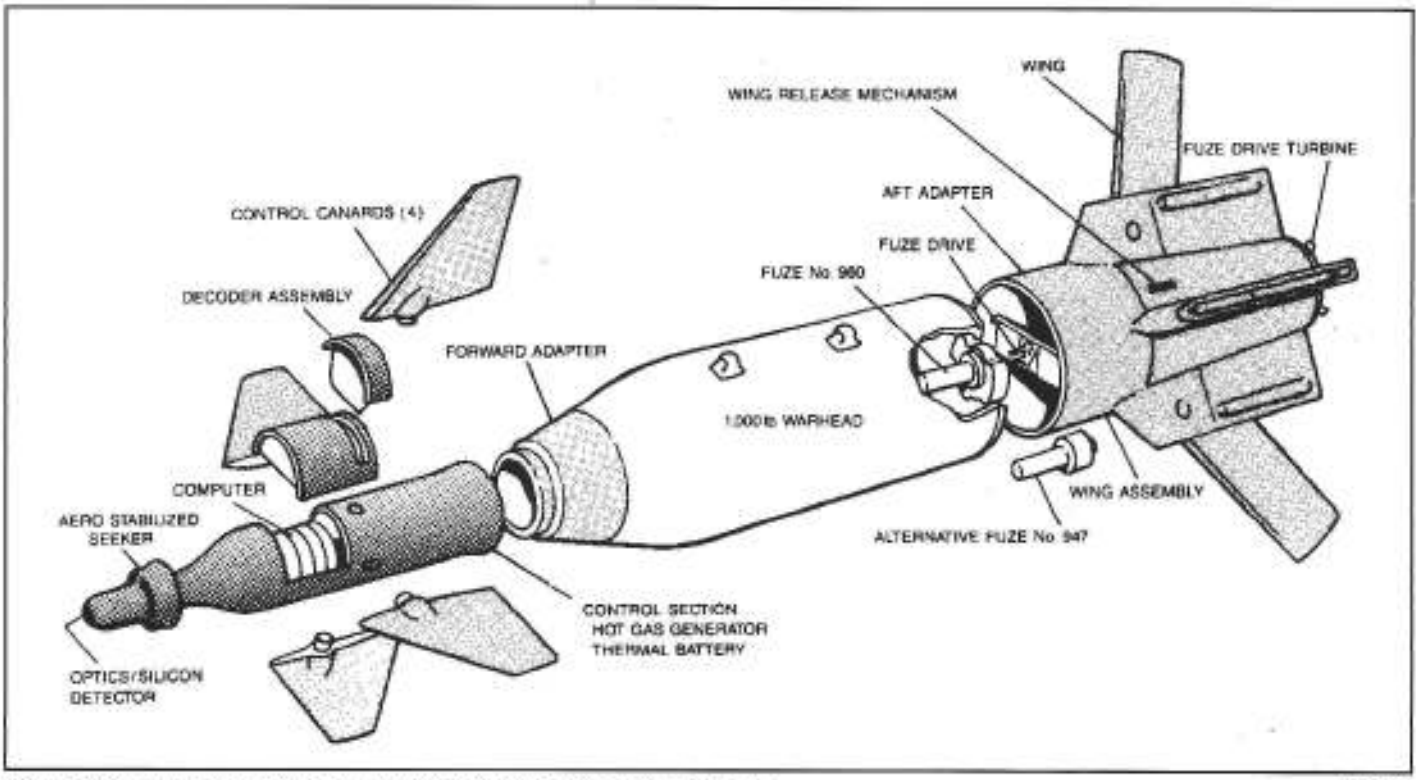


Diagram showing the components of the British Paveway II (Portsmouth Aviation) 0051967

Penetrating bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
broach	various	2-stage warhead	various	various	main warhead: hard-target smart fuze	356 mm	in service	accepts various warheads and guidance kits

Guided bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
Paveway II	450 kg	184 kg Torpex	3.55 m	420 mm	MFBF No 960	356 mm	in service	based on Mk 20 and 22 bombs
Paveway III	1,135 – 1,156 kg	240 kg Tritonal	4.44 m	370 mm	n/k	356 or 762 mm	in service	based on BLU-109 warhead

United States

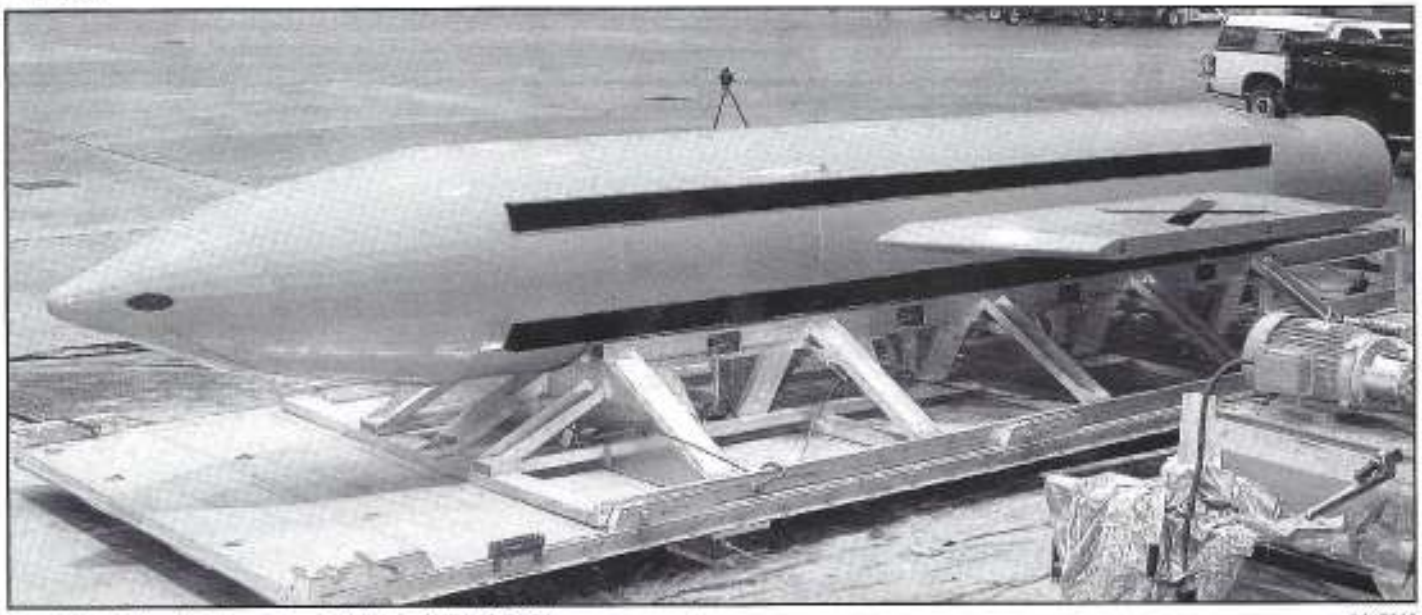
General purpose bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BLU-33/B	680 kg	HE	n/k	n/k	n/k	762 mm	uncertain	general purpose bomb
BLU-58/B	226 kg	HE	n/k	n/k	n/k	356 mm	uncertain	general purpose bomb
BLU-71/B	497 kg	HE	n/k	n/k	n/k	762 mm	uncertain	designated as a 'land mine'
BLU-82 'Daisy Cutter'	6,800 kg	5,715 kg 'GSX' (AN/Al slurry)	5.37 m	1.56 m	M904 (nose); M905 (tail) impact	n/k	in service	uses M904 nose fuze on a 1.24 m nose probe
Mk 81	118 kg	45 kg, *Note 1*	1.88 m	228 mm	nose/tail, *Note 2*	356 mm	in service	low drag

United States (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
Mk 82	241 kg	89 kg, *Note 1*	2.21 m	273 mm	nose/tail, *Note 2*	356 or 762 mm	in service	low drag (see Notes)
Mk 83	447 kg	202 kg, *Note 1*	3.0 m	350 mm	nose/tail, *Note 2*	356 or 762 mm	in service	low drag (see Notes)
Mk 84	894 kg	428 kg, *Note 1*	3.38 m	460 mm	nose/tail, *Note 2*	762 mm	in service	low drag (see Notes)
M 117 (MAU-103 fin)	340 kg	175 kg Tritonal or Minol II	2.16 mm	408 mm	nose/tail, *Note 2*	356 mm	in service	low drag (see Notes)
M 117R (MAU-91 fin)	340 kg	175 kg Tritonal or Minol II	2.06 mm	408 mm	nose/tail, various	356 mm	in service	selected low drag or retarded blast bomb

Note 1: May contain Tritonal, Minol II or H-6 explosive; recent US Navy bombs have thermal coatings and may contain PBXN-109.
Note 2: Generally uses M904 nose fuze and M905 tail fuze; FMU-113 (airburst) or FMU-139 (impact/delay) in retarded mode.
General: The following 'Ballute' retarding tail systems can be used with GP bombs: BSU-49/B with Mk82; BSU-50/B with Mk84; BSU-85/B with Mk 83 and BSU-93 with M 117 (see photograph). Naval bombs have a rough thermal coating.



The US 9,800 kg MOAB contains 8,200 kg of HE (US DoD) 0547210

The US 6,800 kg BLU-82/B 'Daisy Cutter' blast bomb (Paul Jackson) 0006411

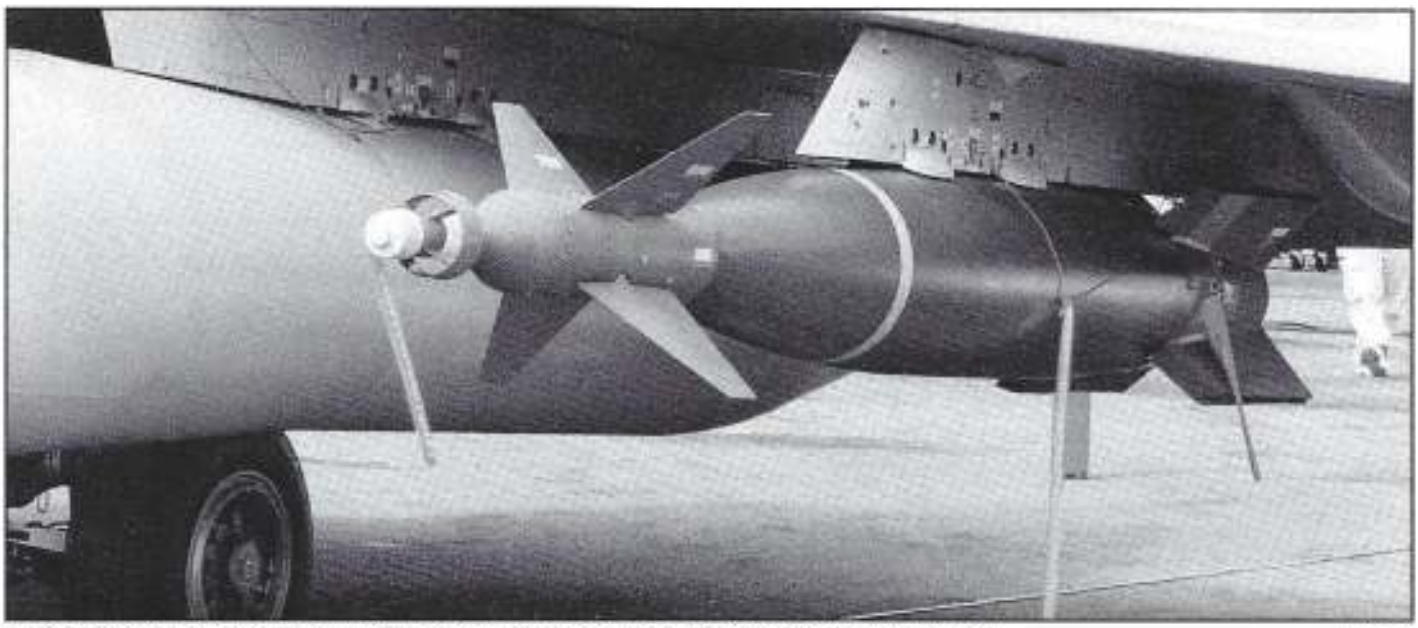
United States (continued)

Fragmentation bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BLU-14	348 kg	HE	n/k	n/k	influence sensors	356 mm	uncertain	MLU-10/B mine used for bombing
BLU-57/B	226 kg	HE frag	n/k	n/k	n/k	356 mm	uncertain	

Penetrating bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BLU-31/B	340 kg	HE	n/k	n/k	influence sensors	365 mm	in service	anti-tank bomb based on MLU-10 mine
BLU-34/B	1,360 kg	HE	n/k	n/k	n/k	762 mm	in service	designed for use against hardened targets
BLU-109/B	874 kg	240 kg Tritonal	2.4 m	370 mm	tail, FMU-143 series	762 mm	in service	specifications are without tail unit fitted
BLU-111 warhead	227 kg	89 kg PBXN-109	n/k	273 mm	n/k	n/a	in development	provisional unitary warhead for JSOW AGM-154C
BLU-113	2,130 kg	306 kg Tritonal	n/k	370 mm	tail, FMU-143 series	762 mm	in development	
BLU-116/B	770 kg	109 kg PBXN	2.4 m	254 mm	tail (FMU-157 'HTSF')	762 mm	in service	
GBU-27	900 kg	240 kg Tritonal	4.24 m	370 mm	tail (FMU-143 or 152)	762 mm	in service	uses BLU-109 bomb body
GBU-28	2,130 kg	306 kg Tritonal	5.72 m	370 mm	tail (FMU-143 or 152)	762 mm	in service	
GBU-32 JDAM Mk 84	n/k	428 kg HE	4.0 m	450 mm	tail (FMU-143 or 152)	762 mm	in service	
GBU-32 JDAM BLU-109/B	n/k	240 kg HE	n/k	370 mm without adaptor	tail (FMU-143 or 152)	762 mm	in service	
GBU-37	2,130 kg	286 kg HE	5.8 m	370 mm	tail (FMU-143)	762 mm	in service	
I-250 (SSB)	113 kg	22.6 kg HE	1.83 m	152 mm	tail (FMU-152 'HTSF')	356 mm	in development	
I-1000	454 kg	HE	n/k	n/k	tail (FMU-152 'HTSF')	356 or 762 mm	in development	



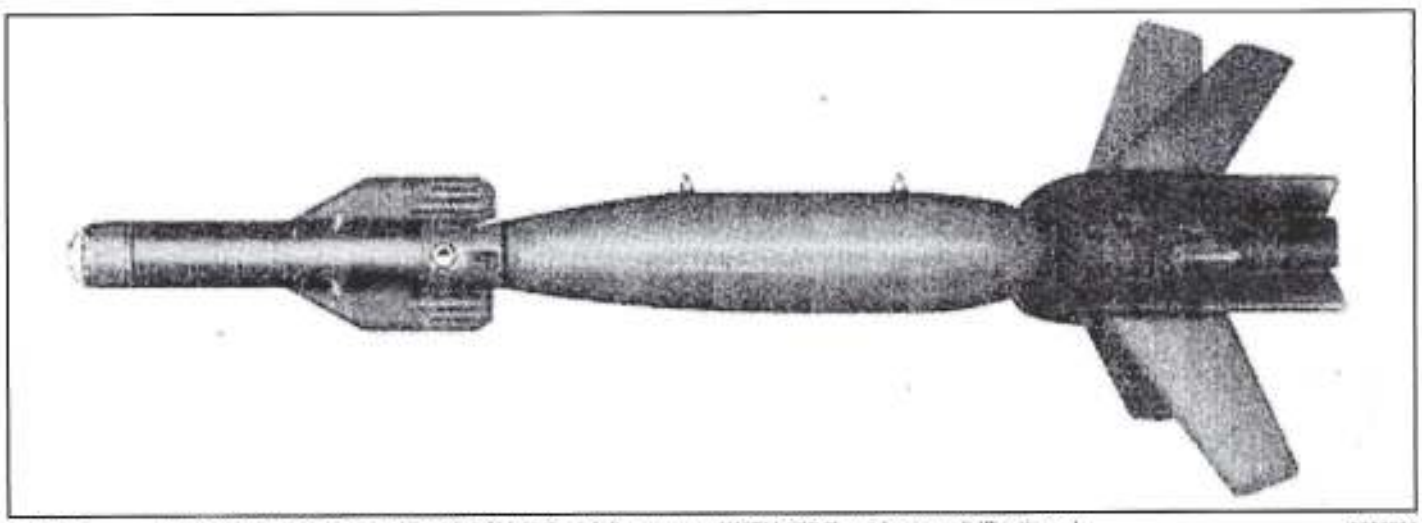
A US GBU-10 with Paveway II laser guidance system fitted to a 2,000 lb Mk 84 warhead (Duncan Lennox)

0022967

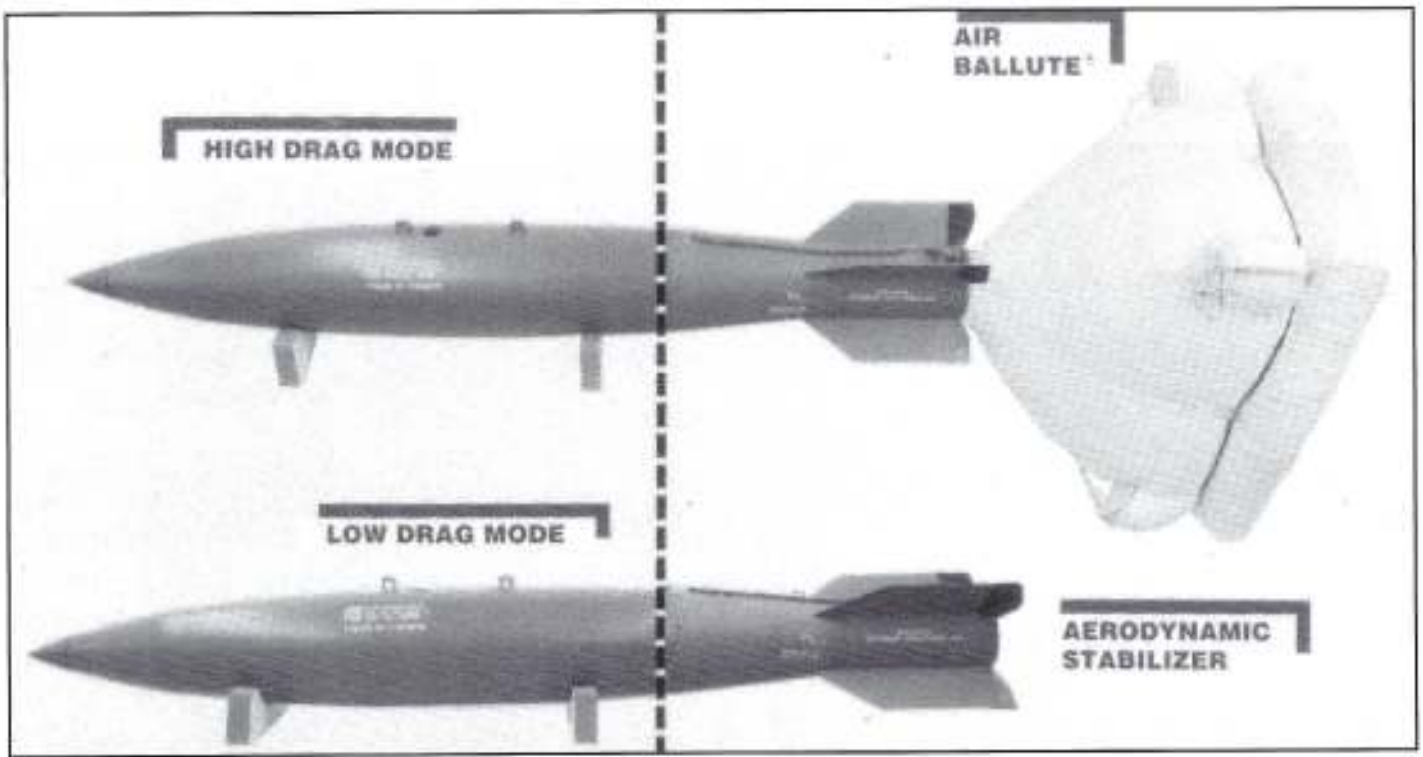
United States (continued)

Guided bombs

Designation	Weight	Filling	Length diameter	Body	Fuzing	Lug spacing	Status	Remarks
AGM-62 Walleye 1	510 kg	202 kg HE	3.38 m	396 mm	n/k	356 or 762 mm	in service	TV-guided, uses Mk 83 bomb as warhead
AGM-62 Walleye 2	1,088 kg	424 kg HE	4.05 m	457 mm	n/k	762 mm	in service	TV-guided, uses Mk 84 bomb as warhead
GBU-10C, -D, -E, -F	900 kg	428 kg HE	4.43 m	460 mm	nose/tail, various	762 mm	in service	Paveway II laser guidance, uses Mk 84 as warhead
GBU-10G, -H, -J	900 kg	240 kg Tritonal	4.26 m	370 mm	tail (FMU-143 or 152)	762 mm	in service	Paveway II laser guidance, uses BLU-109/B penetrating bomb as warhead



A US 'Paveway III' GBU-22/B (Mk 82 bomb) with BSU-82/B airfoil group and WGU-12B/B guidance unit (Raytheon) 0051954



'Ballute' retard tail system fitted to a Mk 82 GP bomb 0504622

United States (continued)

Designation	Weight	Filling	Length diameter	Body	Fuzing	Lug spacing	Status	Remarks
GBU-12B, -C, -D	227 kg	89 kg Tritonal	3.33 m	273 mm	nose/tail, various	356 or 762 mm	in service	Paveway II laser guidance, uses Mk 82 as warhead
GBU-15	1,140 kg	HE	3.94 m	460 mm	tail, various	762 mm	in service	TV or IR guided, uses Mk 84 or BLU-109/B bombs as warhead
GBU-16A, -B	454 kg	202 kg Tritonal	3.68 m	350 mm	*Note 3*	356 or 762 mm	in service	Paveway II laser guidance, uses Mk 83 as warhead
GBU-22/B	326 kg	89 kg Tritonal	3.5 m	273 mm	*Note 3*	356 or 762 mm	in service	Paveway III laser guidance, uses Mk 82 as warhead
GBU-24/B	900 kg	428 kg Tritonal	4.39 m	460 mm	*Note 3*	762 mm	in service	Paveway III laser guidance, uses Mk 84 as warhead
GBU-24A/B	900 kg	240 kg Tritonal	4.31 m	370 mm	tail (FMU-143 or 152)	762 mm	in service	Paveway III laser guidance, uses BLU-109/B penetrating bomb as warhead
GBU-27/B	984 kg	240 kg Tritonal	4.24 m	370 mm	tail (FMU-143 or 152)	762 mm	in service	Paveway III laser guidance, uses BLU-109/B penetrating bomb as warhead
GBU-28/B	2,130 kg	306 kg Tritonal	5.84 m	370 mm	tail (FMU-143 or 152)	762 mm	in service	Paveway III laser guidance, uses special warhead made from 200 mm gun barrel
MOAB	9,800 kg	8,200 kg Tritonal	9.45 m	1.03 m	nose, two M904s	n/k	in service	GPS-guided

Note 3: The fuzes most likely to be fitted are: M905 (tail), FMU-26 (nose/tail), FMU-81 (nose/tail), Mk 344 (tail) and Mk 376 (tail).

General: The Multi-Function Bomb Fuze (MFBF 960) and Hard Target Smart Fuze (FMU-157) can also be fitted to several guided and penetration bombs. JDAM and Paveway guidance systems may be used with bombs listed in separate tables, such as the GBUs shown under *Penetrating bombs*.

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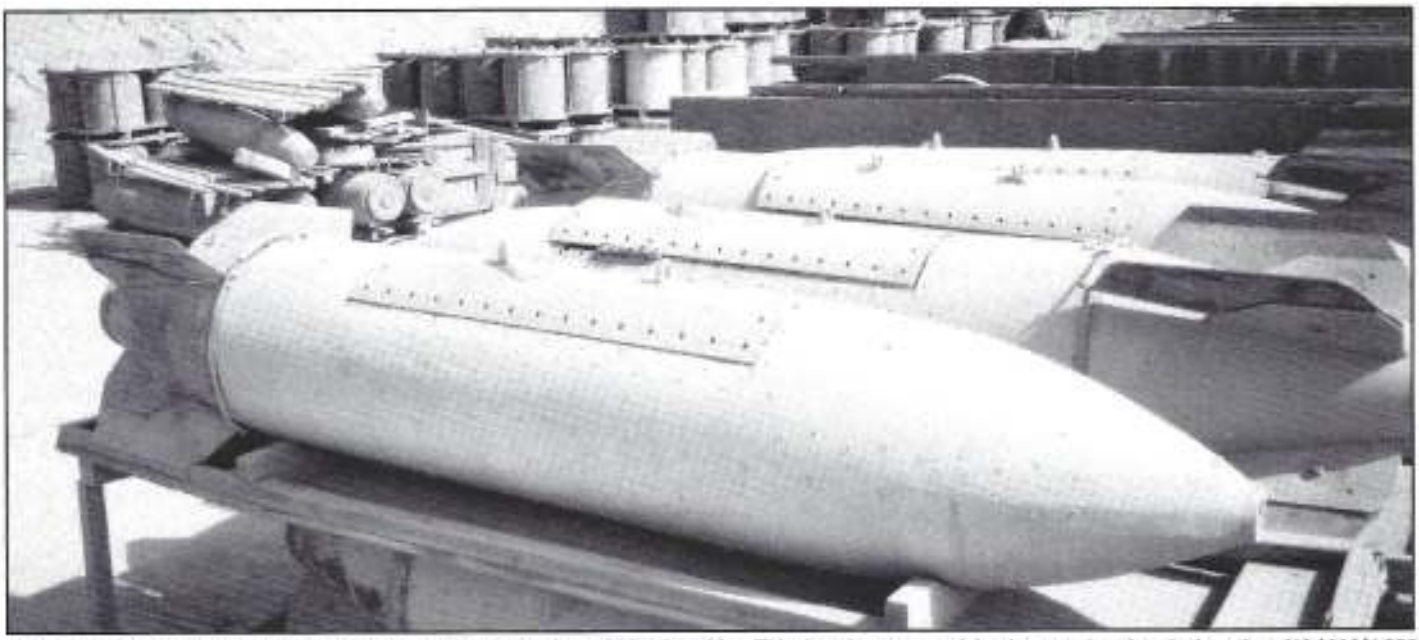
CLUSTER BOMBS AND DISPENSERS

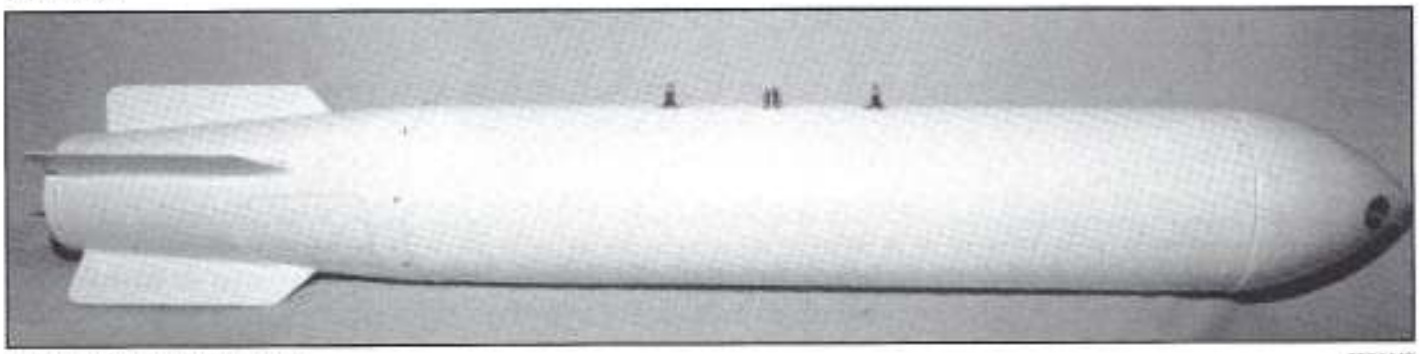
Chile

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BLG-120	120 kg	86 BLG bomblets	2.12 m	292 mm	mechanical delay, 2–18 s	250 or 356 mm	See note	
BLG-252	325 kg	248 BLG bomblets	2.97 m	400 mm	mechanical delay, 2–18 s	250 or 356 mm	See note	
CB-130	60 kg	50 PM-1 bomblets	2.05 m	260 mm	nose, variable electronic delay	356 mm	See note	multipurpose weapon
CB-500	245 kg	240 PM-1 bomblets	2.46 m	446 mm	nose, variable electronic delay	single, 250 and 356 mm	See note	
CB-250-K	250 kg	240 PM-1 bomblets	2.5 m	440 mm	nose, variable electronic delay	single, 250 and 356 mm	See note	multipurpose weapon
CB-500-K	445 kg	400 PM-1 bomblets	3.28 m	660 mm	nose, variable electronic delay	single, 250 and 356 mm	See note	multipurpose weapon
CB-500-K-2	485 kg	431 PM-2 bomblets	2.5 m	440 mm	nose, variable electronic delay	single, 250 and 356 mm	See note	multipurpose weapon
CB-770	400 kg	121 PM-3 bomblets	2.55 m	440 mm	nose, variable electronic delay	250 and 356 mm	See note	area denial weapon
WB-250-F	113 kg	130 bomblets	2.4 m	320 mm	nose, variable electronic delay	356 mm	See note	may carry HEAT or frag bomblets
WB-500-F	227 kg	240 bomblets	2.37 m	480 mm	nose, variable electronic delay	single, 250 and 356 mm	See note	may carry HEAT or frag bomblets
WV-500-FI	260 kg	250 bomblets	2.73 m	370 mm	nose, variable electronic delay	356 mm	See note	may carry HEAT or frag bomblets

Note: No longer in production. Banned and due for destruction under the terms of the 2008 Cluster Munitions Convention (CCM).



Chilean CB-250-K cluster bomb, which carries the Cardoen PM-1 bomblet. This bomb was used by Iraq under the designation NAAMAN-250
(Colin King) 0573255

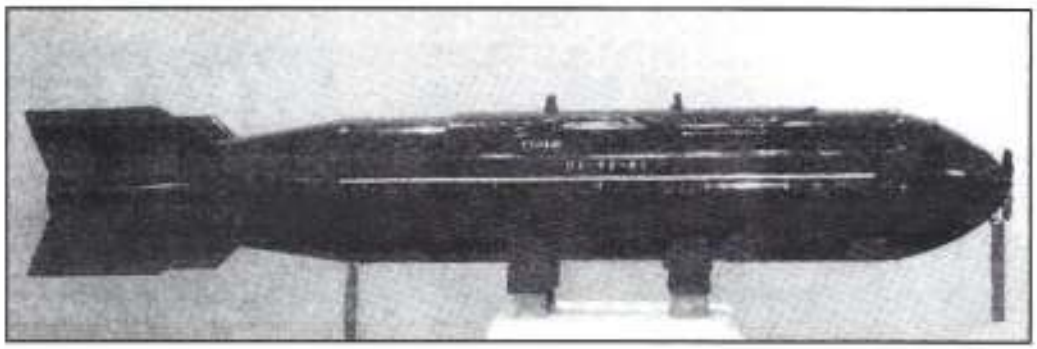


WB-250-F 250 kg cluster bomb 0504448

China

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
Anti-Runway	360 kg	12 bomblets	2.65 m	410 mm	nose, delay	250 and 356 mm	in service	tandem-charged penetrating bomblet
Anti-Tank	350 kg	16 × 4.5 kg bomblets	2.5 m	410 mm	nose, delay	250 and 356 mm	in service	shaped-charge sensor-fuzed bomblet
Type 2	250 kg	42 AP, 28 APAM or 26 HEAT bomblets	n/k	n/k	nose, delay	250 and 356 mm	in service	small version of 350 kg cluster bomb
Type 250; 340 kg Anti-Tank	340 kg	189 dual-purpose bomblets	2.75 m	419 mm	nose, delay	single or 250 mm	in service	

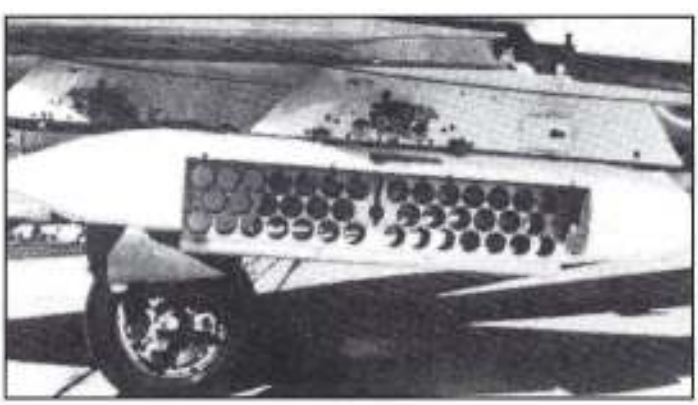
Note: China also produces a fuel-air cluster bomb; see entry under *Other bomb types.*



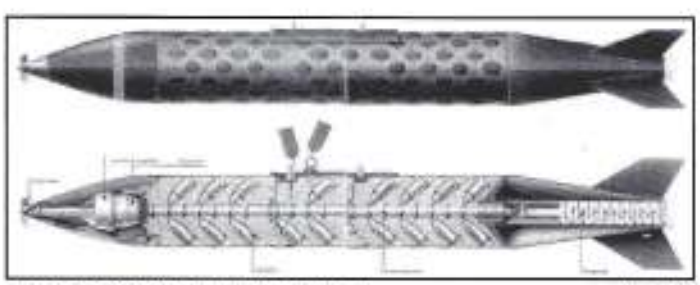
Chinese 340 kg Anti-Tank cluster bomb
(NORINCO)
0022884

France

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
Alkan type 500	n/k	20 grenades	1.85 m	312 mm	pilot command	356 mm	See *Note 1*	aircraft dispenser
Alkan type 530	n/k	40 grenades	2.23 m	340 mm	pilot command	356 mm	See *Note 1*	aircraft dispenser
Alkan type 5030	n/k	4 × 38 grenades	5.1 m	744 mm	pilot command	762 mm	See *Note 1*	aircraft dispenser
Alkan type 5050	n/k	3 × 64 grenades	1.85 m	312 mm	pilot command	356 mm	See *Note 1*	aircraft dispenser
B-7	n/k	4 × BAP 100 or 4 × BAT 120	2.34 m	335 mm	programmable, type n/k	156 mm	in development	modified Mk 20 Rockeye dispenser
BM 400	390 kg	3 × 100 kg fragmentation submunitions	3.2 m	320 mm	programmable sequencer in nose cone	356 mm	in service	
BLG 66 Belouga	305 kg	151 submunitions	3.33 m	360 mm	programmable sequencer in nose cone	356 mm	See *Note 1*	three submunition types



Alkan type 530 dispenser, with side panel removed
0001982



French BLG 66 'Belouga' cluster bomb 0504469

France (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
CASCAD Mk 1	390 kg	3 submunitions	3.2 m	320 mm	programmable delay fuze in nose cone	356 mm	in production	
CASCAD Mk 2	435 kg	12 bomblets	3–3.5 m	300–400 mm	programmable delay fuze in nose cone	356 mm	in development	incorporates a rocket motor
CEM-1	n/k	2 × 125 kg or 1 × 250 kg bomb	n/k	n/k	n/k	356 mm or 762 mm	in service	

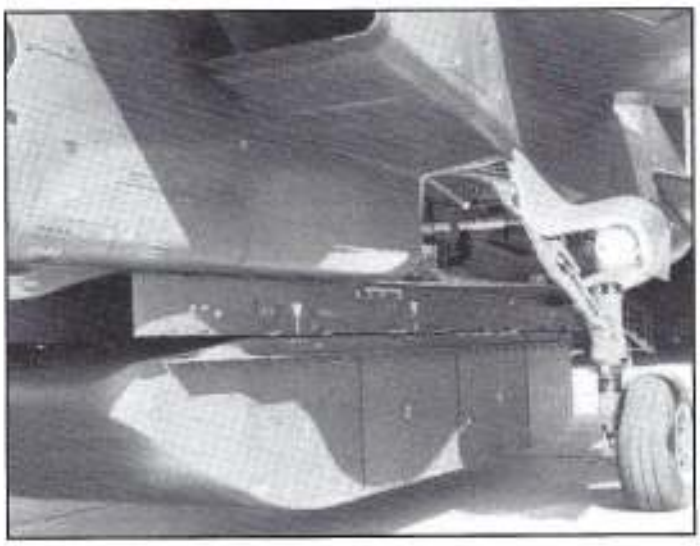
Note 1: No longer in production. Banned and due for destruction under the terms of the 2008 Cluster Munitions Convention (CCM)

Germany

Designation	Weight	Filling	Length	Body diameter (W × H)	Fuzing	Lug spacing	Status	Remarks
DWS 24/39	600 kg	see *Note 1*	3.5 m	630 × 320 mm	linked to guidance system	762 mm	See *Note 2*	DWS 39 in service with Sweden
MDS	500 to 2,000 kg	see *Note 1*	2.5–4.5 m	630 × 360 mm	pilot command	variable	See *Note 2*	aircraft dispenser
MW-1	4,700 kg	see *Note 1*	5.33 m	1.32 m × 650 mm	pilot command	n/k	no longer in service See *Note 2*	aircraft dispenser
VBW	350 kg	18 submunitions	4.0 m	550 mm	pilot command	356 or 762 mm	believed to be in development	aircraft dispenser

Note 1:
Submunition options included KB 44, MIFF, MUSA, MUSPA, STABO and MUJAS 2: see *Submunitions*.

Note 2:
Submunitions that fall under the terms of the 2008 Cluster Munitions Convention (CCM) are banned and due for destruction.



The DWS 39 submunition dispenser, in service with Sweden as Bk 99
0504502

The MW-1 submunition dispenser
0504504

International

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
AFDS (Autonomous Free-flight Dispenser System)	600 kg	various; *see Notes*	3.47 m	630 × 320 mm	linked to guidance system	762 mm	in service	uses GPS/ inertial navigation system

International (continued)

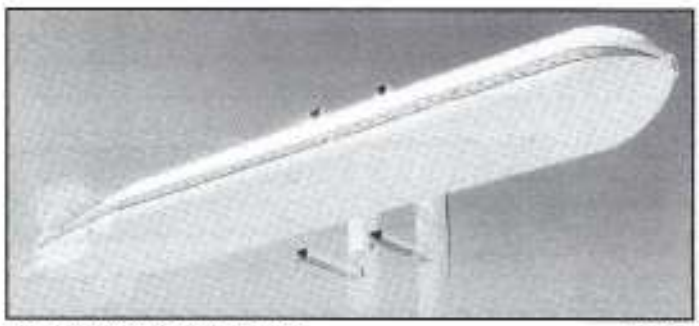
AFDS dispenser (CMS Inc)
0504936

Note: HE submunition options include SB 44, ATM, AMS, ADM, RCB and M42; see *Submunitions*. Signatories to the 2008 Cluster Munitions Convention (CCM) cannot use this weapon with submunitions defined under the terms of the Treaty.

Iraq

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
NAAMAN 250 kg	250 kg	240 bomblets; *see Note*	2.79 m	n/k	nose, variable delay	250 or 356 mm	in service	Iraqi version of Chilean CB-250-K cluster bomb
NAAMAN 500 kg	500 kg	400 bomblets; *see Note*	3.30 m	438 mm	nose, variable delay	250 or 356 mm	in service	Iraqi version of Chilean CB-500-K cluster bomb

Note: Most bombs appear to have carried the Chilean PM-1 bomblet, but other submunitions, such as the Russian PTAB-2.5M, may have been used.

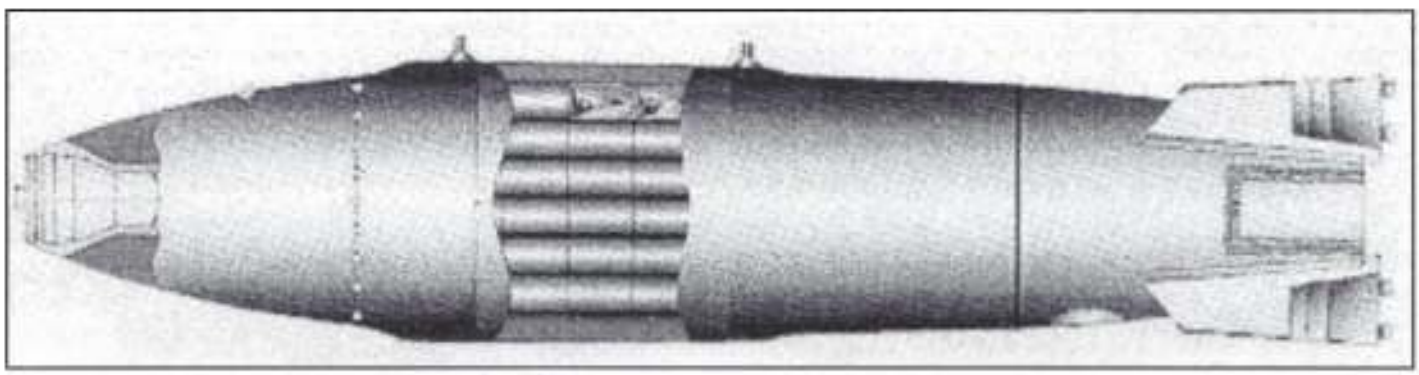


NAAMAN-500 kg cluster bomb 0504815

NAAMAN-250 cluster bombs in Iraq (Colin King)
0573256

Israel

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
ATAP-1000	384 kg (empty), 450 kg (filled)	900 Bantam DPICM	2.12 m	406 mm	nose or tail	356 mm	in service	See Note
ATAP-300	384 kg (empty)	320 Bantam DPICM	2.12 m	406 mm	nose or tail	356 mm	in service	See Note



Cutaway diagram of an Israeli ATAP cluster bomb (TAAS) 0022898

Israel (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
ATAP-500	384 kg (empty)	512 Bantam DPICM	2.12 m	406 mm	nose or tail	356 mm	in service	See Note
BARAD	153 kg	72 DPICM (believed to be Bantam)	1.7 m	460 × 440 mm	pilot command	n/a	in service	dispenser carried by helicopters
TAL 1	220 kg	270 DPICM	2.34 m	406 mm	nose, programmable	356 mm	in service	
TAL 2	250 kg	315 DPICM	2.34 m	406 mm	nose, programmable	356 mm	in service	

Note: All ATAP bombs share the same body. On fuze activation, the casing is split by four linear cutting charges.

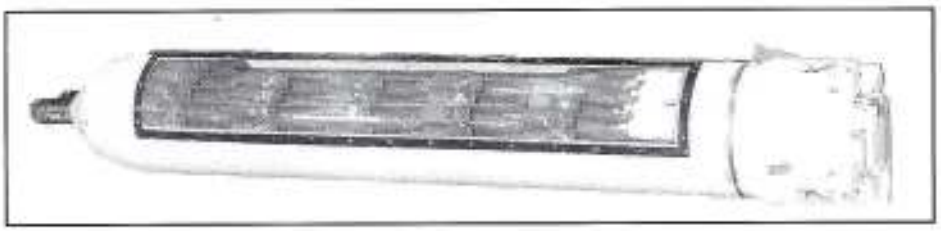
Italy

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
Skyshark	1,050 kg	745 kg submunitions	4.76 m	650 × 810 mm	n/k	n/k	see Note	range 6–12 km

Note: Formerly in development, but banned under the terms of the 2008 Cluster Munitions Convention (CCM)

Pakistan

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
PSD-1	222 kg	225 delay-fuzed fragmentation bomblets	2.34 m	335 mm	nose, variable delay	356 mm	in service	similar to the US Rockeye II dispenser
TSD-1 'Hijara'	222 kg	247 'Rockeye'-type DP bomblets	2.34 m	335 mm	nose, variable delay	356 mm	in service	similar to the US Rockeye II dispenser



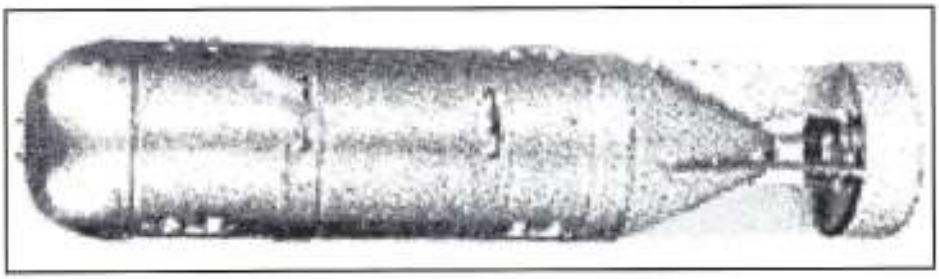
Cutaway model of the PSD-1, which is similar to the US Rockeye II (AWC)
0106145

Poland

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
ZK-300 Kisajno bomb	465 kg	315 LBOk-1 fragmentation bomblets	3.4 m	n/k	n/k	250 mm	in service	similar to Russian KMG-U bomb dispenser

Romania

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
CL-250	75 kg	AP or AT bomblets	1.5 m	325 mm	TM-24B nose fuze	250 mm	in service	similar to RBK-250



CL-250 (ROMAIR)
0022877

Russian Federation

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
KMG-U	525 kg	Various: *Note 1*	3.7 m	460 mm	pilot command	250 mm	in service	aircraft dispenser, pneumatically operated
PROSAB-250	250 kg	90 bomblets	1.85 m	400 mm	n/k	250 mm	in service	area denial fragmentation bomblet
RBK-250	194 kg	48 ZAB-2.5 bomblets	2.12 m	325 mm	nose, variable delay	250 mm	in service	
RBK-250–275	250–275 kg	various	2.12 m	325 mm	nose, variable delay	250 mm	in service	multipurpose with several bomblet options
RBK-500	500 kg	various	2.5 m	450 mm	nose, variable delay	250 mm	in service	multipurpose with several bomblet options
RBK-500 A0-2.5 RTM	504 kg	108 bomblets	2.5 m	450 mm	nose, variable delay	250 mm	in service	bomblet is A0-2.5 RTM anti-personnel/ material
RBK-500 BETAB	525 kg	12 bomblets	2.5 m	450 mm	nose, variable delay	250 mm	in service	airfield cratering bomblets
RBK-500 PTAB-1M	427 kg	268 bomblets	1.95 m	450 mm	nose, variable delay	250 mm	in service	anti-tank bomblets
RBK-500 ShOAB	334 kg	565 bomblets	1.5 m	450 mm	nose, variable delay	250 mm	in service	anti-personnel bomblet
RBK-500 SPBE	467 kg	14 bomblets	2.5 m	450 mm	n/k	250 mm	in service	anti-tank IR bomblet
RBK-500 SPBE-D	500 kg	15 bomblets	2.48 m	450 mm	n/k	250 mm	in service	anti-tank smart bomblet
RBK-500 U	500 kg	various	2.5 m	450 mm	n/k	250 mm	in service	multipurpose weapon with several bomblet options
RBK-500 ZAB 2.5	435 kg	117 ZAB 2.5 bomblets	2.5 m	450 mm	nose, variable delay	250 mm	in service	

Note 1: Submunition loads include: 96 × AO-2.5, 8 × ODS-OD (FAE), 96 × PTAB-2.5KO, 248 × PTAB-1M.

An RBK-250 with the tail removed and two PTAB-2.5M bomblets (Colin King) 0074849

KMG-U dispensers in Iraq. These dispensers can be used with a variety of Russian submunitions (Colin King) 0588946

South Africa

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
CB 470	450 kg	40 spherical 'Alpha' bomblets	2.6 m	419 mm	nose, delay	250 or 356 mm	See Note	bomblets are anti-personnel fragmentation

Note: No longer in production. Banned and due for destruction under the terms of the 2008 Cluster Munitions Convention (CCM)

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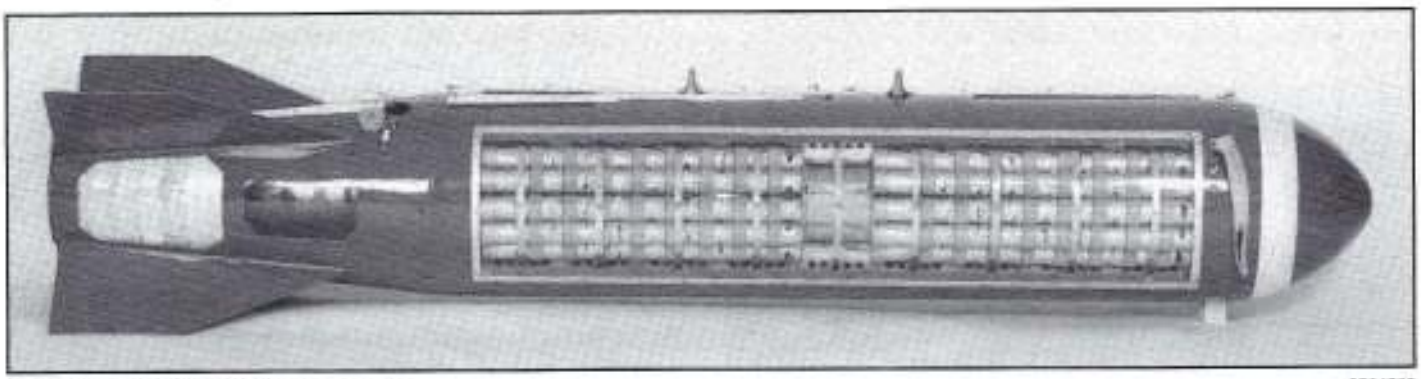
South Africa (continued)

South African CB 470 cluster bomb and its load of 40 Alpha bomblets (T J Gander)
0504562

Spain

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
ABL-250	250 kg	250 DP bomblets	2.25 m	335 mm	nose, delay	250 or 356 mm	See Note	bomblet is similar to US Rockeye
BME 330 C	317 kg	180 CP, CH or SNA bomblets	2.25 m	350 mm	delay, mounted in nose cone	250 or 356 mm	See Note	multipurpose weapon
BME 330 AR	317 kg	8 SAP and 20 SNA bomblets	2.25 m	350 mm	delay, mounted in nose cone	250 or 356 mm	See Note	anti-runway weapon
BME 330 AT	317 kg	512 SAC-1 bomblets and 4 MAC-2 mines	2.25 m	350 mm	delay, mounted in nose cone	250 or 356 mm	See Note	anti-tank weapon

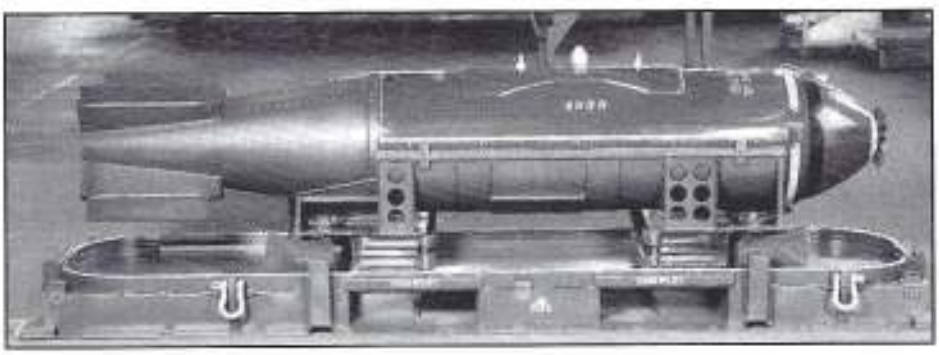
Note: No longer in production. Banned and due for destruction under the terms of the 2008 Cluster Munitions Convention (CCM)



Cutaway of the BME 330 AT cluster bomb
0504585

United Kingdom

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BL 755	227 kg	147 bomblets	2.45 m	419 mm	nose, variable delay	250 or 356 mm or single	See *Note 1*	'GP' dual-purpose bomblets



British BL 755 cluster bomb (HEL)
0006400

United Kingdom (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
IBL 755	227 kg	147 bomblets	2.45 m	419 mm	nose, radar proximity	250 or 356 mm or single	See *Note 1*	Advanced Anti-Armour (AAA) dual-purpose bomblets
CMD 18	900 kg	18 bomblets	4.29 m	656 mm wide 640 mm deep	pilot command	762 mm	development cancelled	aircraft dispenser
JP 233 (HB 876 module)	1,150 kg	215 mines	4.24 m	840 mm wide 560 mm deep	pilot command	762 mm	withdrawn from UK service around 1998. See *Note 2*	aircraft dispenser; carries HB 876 area denial mines
JP 233 (SG 357 module)	1,370 kg	30 bomblets	5.68 m	840 mm wide 600 mm deep	pilot command	762 mm	withdrawn from UK service around 1998. See *Note 2*	aircraft dispenser; carries SG 357 cratering bomblets
JP 233 (tandem modules)	2,335 kg	215 mines and 30 bomblets	6.55 m	840 mm wide 600 mm deep	pilot command	356 mm front 762 mm rear	withdrawn from UK service around 1998. See *Note 2*	aircraft dispenser; carried HB 876 area denial mines and SG 357 cratering bomblets
SWAARM 1	450 kg	16 bomblets	n/k	n/k	n/k	356 mm	development cancelled	
SWAARM 2	450 kg	16 bomblets	3.3 m	630 × 320 mm	n/k	356 mm	development cancelled	
SWATHE/ TAAWS	280 kg	4TGSM	2.45 m	419 mm	n/k	250 or 356 mm or single	development cancelled	anti-armour Terminal Guided SubMunition (TGSM)

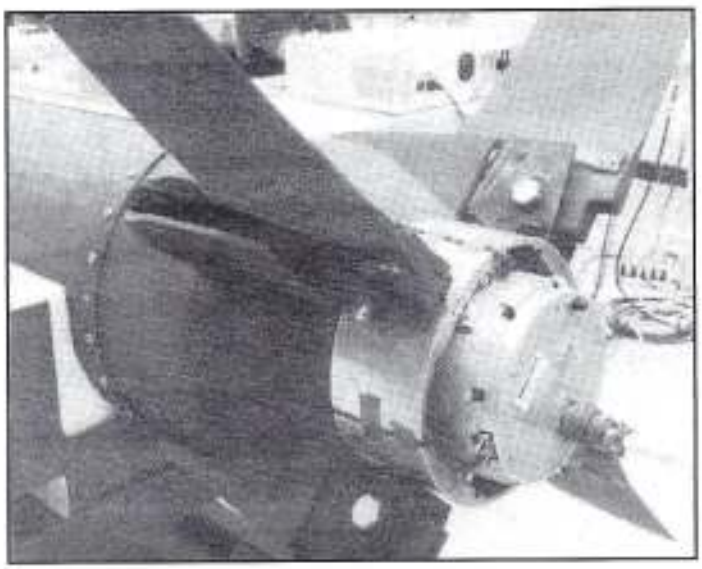
Note 1: No longer in production. Banned and due for destruction under the terms of the 2008 Cluster Munitions Convention (CCM)
Note 2: All HB 876 and SG 357 bomblets have been destroyed

United States

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
AGM-154 JSOW	484 kg	145 BLU-97/B or 6 BLU-108/ B or BLU-111	4.06 m	442 × 337 mm	linked to guidance system	n/k	in service	GPS and inertial navigation
CBU-1/A	Approx 340 kg	509 BLU-4 anti-material bomblets	3.73 m	401 mm	pilot command	356 mm	obsolete	SUU-7 dispenser
CBU-2/A	Approx 340 kg	360 BLU-3/A fragmentation bomblets	3.73 m	401 mm	pilot command	356 mm	obsolete	SUU-7 dispenser
CBU-2B/A	Approx 340 kg	409 BLU-3/A fragmentation bomblets	3.73 m	401 mm	pilot command	356 mm	obsolete	SUU-7 dispenser
CBU-3/A	229 kg	352 BLU-7/B anti-tank bomblets	3.73 m	401 mm	pilot command	356 mm	obsolete	SUU-10/A dispenser
CBU-7/A	n/k	1,200 BLU-18/B anti-personnel bomblets	n/k	n/k	n/k	356 mm	obsolete	SUU-31/A dispenser
CBU-11/A	Approx 340 kg	216 BLU-16/B smoke bomblets	3.73 m	401 mm	pilot command	356 mm	obsolete	SUU-7/A dispenser
CBU-12/A	290 kg	261 BLU-17/B smoke bomblets	3.73 m	401 mm	pilot command	356 mm	in service	SUU-7/A dispenser

United States (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
CBU-13/A	n/k	261 BLU-16/B and BLU-17/B smoke bomblets	n/k	n/k	n/k	356 mm	obsolete	SUU-11/D dispenser
CBU-18/A	Approx 388 kg	BLU-25/B anti-personnel bomblets	2.6 m	366 mm	pilot command	356 mm	obsolete	SUU-13/A dispenser
CBU-22/A	Approx 120 kg	72 BLU-17/B smoke bomblets	2.05 m	287 mm	pilot command	356 mm	obsolete	SUU-14/A dispenser
CBU-24/A	Approx 120 kg	BLU-24/B anti-personnel bomblets	2.05 m	287 mm	pilot command	356 mm	in service	SUU-14/A dispenser
CBU-28/A	n/k	BLU-43/B anti-personnel mines	2.6 m	366 mm	pilot command	356 mm	obsolete	SUU-13/A dispenser
CBU-33/A	350 kg	30 BLU-45/B anti-tank minelets	n/k	n/k	pilot command	356 mm	obsolete	SUU-36/A dispenser
CBU-34/A	n/k	BLU-41/B or -42/B anti-personnel mines	2.6 m	366 mm	pilot command	356 mm	obsolete	SUU-13/A dispenser
CBU-37/A	n/k	BLU-44/B anti-personnel mines	2.6 m	366 mm	pilot command	356 mm	obsolete	SUU-13/A dispenser
CBU-38/A	Approx 388 kg	40 BLU-49/B fragmentation bomblets	2.6 m	366 mm	pilot command	356 mm	in service	SUU-13/A dispenser
CBU-42/A	Approx 388 kg	540 BLU-54/B anti-personnel minelets	2.6 m	366 mm	pilot command	356 mm	obsolete	SUU-38/A dispenser
CBU-47/A	Approx 388 kg	BLU-55/B anti-personnel minelets	2.6 m	366 mm	pilot command	356 mm	cancelled	SUU-13/A dispenser
CBU-51/A	n/k	40 BLU-67/B anti-runway bomblets	2.6 m	366 mm	n/k	356 mm	in service	SUU-13/A dispenser
CBU-52/B	370 kg	254 BLU-61/B fragmentation bomblets	2.33 m	430 mm	nose, Mk 339 or FMU-140M. see Note	356 mm	in service	cluster bomb using SUU-30B/B dispenser
CBU-55/B	250 kg	3 BLU-73/B bomblets	2.4 m	360 mm	nose, Mk 339 or FMU- 140M. see Note	356 mm	in service	bomblets contain 33 kg FAE
CBU-58/B	430 kg	650 BLU-63/B fragmentation bomblets	2.33 m	430 mm	nose, Mk 339 or FMU-140M. see Note	356 mm	in service	cluster bomb using SUU-30B/B dispenser

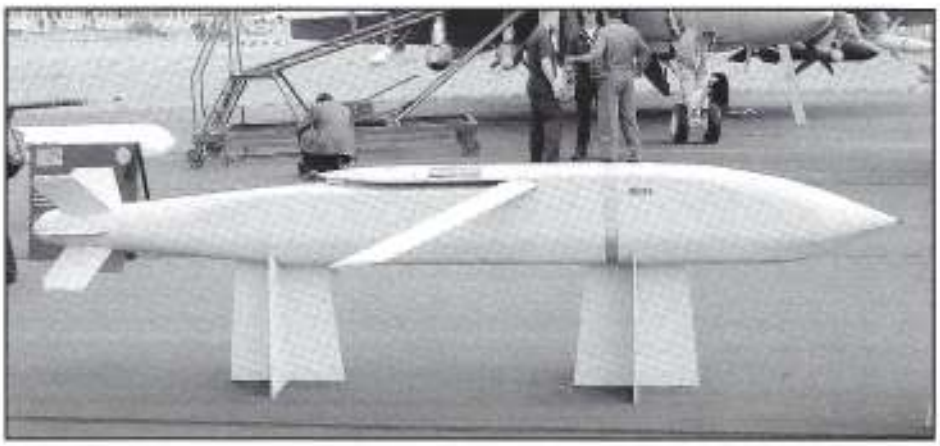


A WCMD tail unit fitted to a CBU-87B
(Lockheed Martin)
0022958

United States (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
CBU-59/B APAM	n/k	717 BLU-77/B APAM bomblets	2.34 m	335 mm	nose, Mk 339 or FMU-140M. see Note	356 mm	in service	cluster bomb using Mk 7 (Rockeye) dispenser
CBU-60/A	340 kg	264 BLU-24/B anti-personnel bomblets	n/k	n/k	n/k	356 mm	obsolete	cluster bomb using SUU-50 dispenser
CBU-72/B	250 kg	3 BLU-73/B bomblets	2.4 m	360 mm	nose, Mk 339 or FMU-140M. see Note	356 mm	in service	low-drag version of CBU-55
CBU-78/B GATOR	222 kg	45 AT and 15 AP Gator mines	2.15 m	335 mm	nose, Mk 339 mechanical delay	356 mm	believed to be cancelled	cluster bomb using Mk 7 (Rockeye) dispenser
CBU-87/B CEM	430 kg	202 BLU-97/B bomblets	2.33 m	396 mm	nose, with FZU-39/B proximity sensor	356 mm	in service	multipurpose weapon using SUU-65/B TMD dispenser
CBU-89/B GATOR	322 kg	72 AT and 22 AP Gator mines	2.34 m	406 mm	nose, with FZU-39/B proximity sensor	356 mm	in service	cluster bomb using SUU-64/B TMD dispenser
CBU-94/B	n/k	BLU-114 submunitions	2.34 m	406 mm	nose, with FZU-39/B proximity sensor	356 mm	in service	cluster bomb using SUU-65/B dispenser
CBU-97/B SFW	450 kg	10 BLU-108/B anti-tank bomblets	2.34 m	406 mm	nose, with FZU-39/B proximity sensor	356 mm	in service	cluster bomb using SUU-64/B TMD dispenser
CBU-103/B WCMD	n/k	202 BLU-97A/B	0.6 m	400 mm	nose, with FZU-39/B proximity sensor	n/a	in service	for CBU-87/-89/-97
CBU-104/B WCMD	n/k	72 BLU-91/B	0.6 m	400 mm	nose, with FZU-39/B proximity sensor	n/a	in service	for CBU-87/-89/-97

The SUU-65/B tactical munitions dispenser, which can be used with BLU-97 and BLU-114 submunitions
0062830



AGM-154 JSOW was used in Iraq and can carry submunitions or unitary warheads
(Janes/Patrick Allen)
1097658

United States (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
ICSB-1 CBU	n/k	165 mines and 65 dummies	2.34 m	335 mm	nose, Mk 339 or FMU-140M. see Note	356 mm	in service	cluster bomb using Mk 7 (Rockeye) dispenser
LAD	600 to 1,200 kg	644 bomblets and SKEET	n/k	n/k		n/k	in development	
LOCAAS	22 kg	HE shaped charge	0.5 m	n/k		n/a	in development	for SUU-64/B TMD
Mk 12 Padeye	272 kg	BZ gas	n/k	n/k	pilot command	356 mm	no longer in service	aircraft dispenser
Mk 21 Sadeye	370 kg	BLU-26/B fragmentation bomblets	n/k	n/k	pilot command	356 mm	in service	aircraft dispenser
Mk 20 Rockeye II CBU	222 kg	247 Mk 118 bomblets	2.34 m	335 mm	nose, Mk 339 or FMU-140M. see Note	356 mm	in service	uses Mk 7 (Rockeye) dispenser
WCMD	n/a	various submunitions	Dispenser length plus 0.6 m	400 mm	nose, with FZU-39/B proximity sensor	n/a	in service	for CBU-87/ -89/-97

Note: The FMU-140M proximity fuze is now replacing the Mk 339 mechanical delay fuze in some applications.

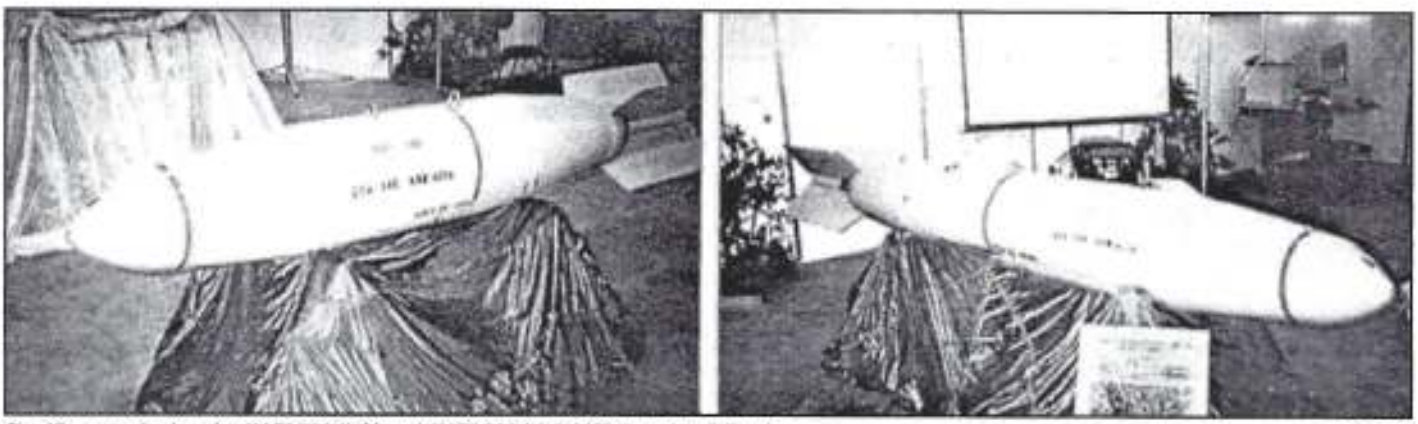
OTHER BOMB TYPES

Brazil

Incendiary bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
AV-BI-200	177 kg	napalm	1.87 m	420 mm	see Note	356 mm	in service	see Note
AV-BI-250	271 kg	napalm	3.46 m	400 mm	see Note	356 mm	in service	see Note
AV-BI-300	300 kg	napalm	n/k	n/k	see Note	356 mm	in service	see Note
AV-BI-375	362 kg	napalm	3.63 m	480 mm	see Note	356 mm	in service	see Note
AV-BI-400	400 kg	napalm	n/k	n/k	see Note	356 mm	in service	see Note

Note: These bombs are believed to be based on early US BLU-series fire bombs, and probably use two mechanical all-ways acting fuzes with white phosphorus igniters.



Brazilian napalm bombs AV-BI-200 (left) and AV-BI-300 (right) (Christopher F Foss) 0052868

Chile

Incendiary bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
30 gallons	n/k	30 gal napalm	n/k	n/k	see Note	356 mm	in service	see Note
60 gallons	228 kg	60 gal napalm	n/k	n/k	see Note	356 mm	in service	see Note
100 gallons	n/k	100 gal napalm	n/k	n/k	see Note	356 mm	in service	see Note

Note: These unstabilised bombs are believed to be based on early US BLU-series fire bombs, and probably use two mechanical all-ways acting fuzes with white phosphorus igniters.

Chilean 60 gallon (228 kg) napalm bomb (Arthur Rees) 0504446

China

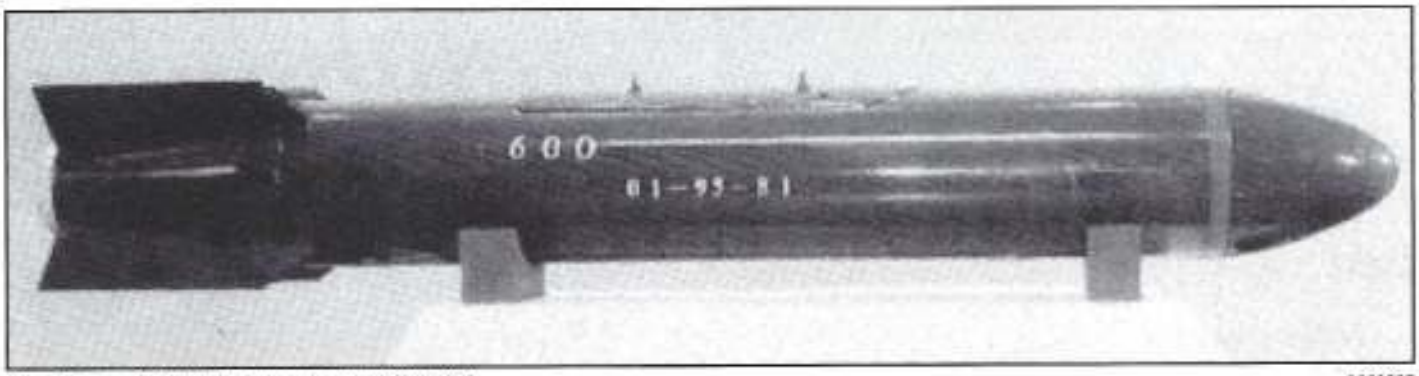
Fuel-air explosive bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
Fuel/Air cluster bomb	310 kg	3 FAE bomblets	2.88 m	362 mm	n/k	250 or 356 mm	in service	Offered for export

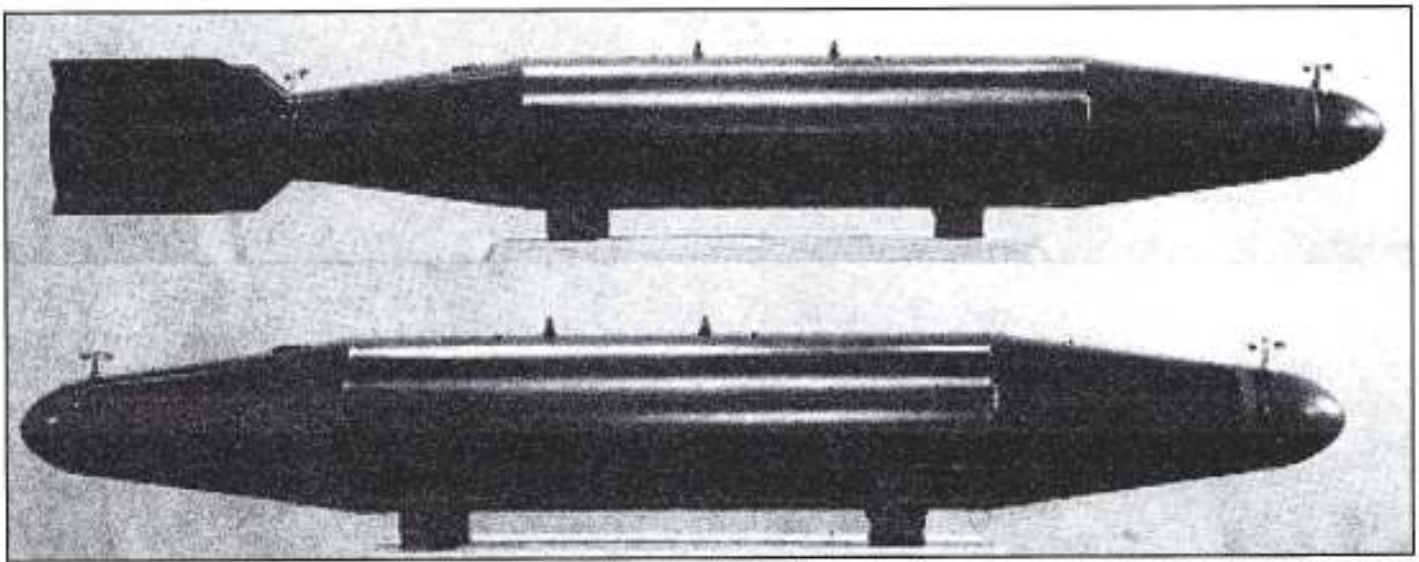
Note: A 250 kg bomb containing 2 FAE bomblets is also believed to have been produced.

Incendiary bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
250 kg Type 1 HE/incendiary	220 kg	15 kg HE and 50 kg incendiary	1.5 m	325 mm	Nose and tail, Hang-Yin Type 1 impact	single and 250 mm	in service	High drag
250 kg Type 1 incendiary	250 kg	135 or 180 kg incendiary	1.51 m	325 mm	Tail, Hang-Yin Type 1 impact	single and 250 mm	in service	High drag
250 kg incendiary	267 kg	220 kg incendiary	3.45 m	400 mm	Nose and tail; probably all-ways acting	250 or 356 mm	in service	Low drag
250 kg incendiary	261 kg	220 kg incendiary	3.03 m	400 mm	Nose and tail, all-ways acting	250 or 356 mm	in service	Low drag, low level



The Chinese 310 kg FAE cluster bomb (NORINCO) 0022885



Chinese incendiary bombs: 250 kg low-drag (above) and 250 kg low-level (below). Note the fuze wind vanes on the nose and tail of each bomb (NORINCO) 0022886

France

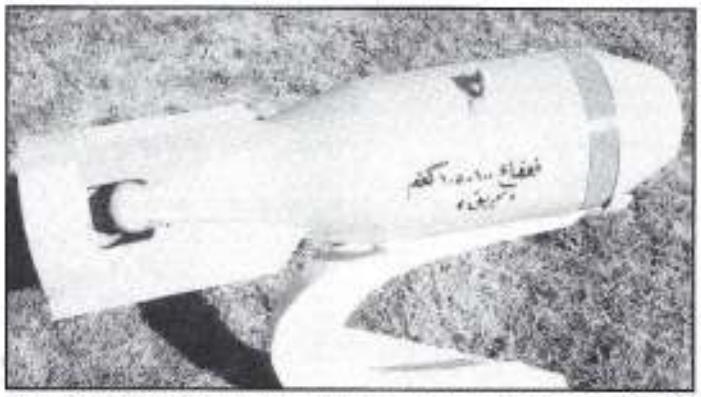
Incendiary bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BL 99	450 kg	350 litres incendiary agent	4.1 m	390 mm	Nose, optional impact or height	356 mm	in service	Central burster charge runs full length of bomb

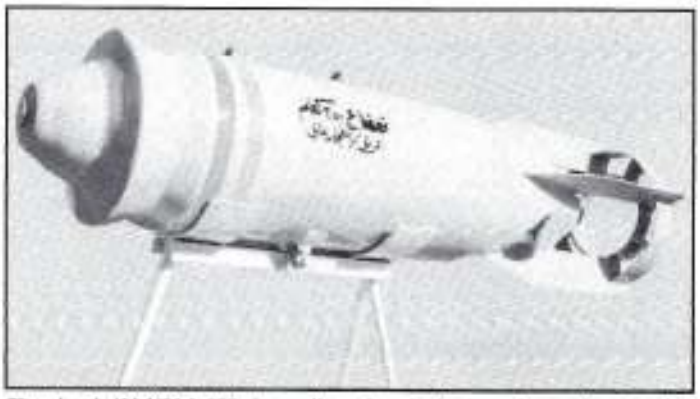
Iraq

Incendiary bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
KAAKAA 100	100–105 kg	incendiary agent	1.05 m	273 mm	Nose/tail, impact	250 mm or single	in service	High drag, same as Russian ZAB
KAAKAA 250	250 kg	incendiary agent and HE	1.49 m	323 mm	Nose/tail, impact	250 mm or single	In service	High drag, same as Russian ZAB



Iraqi KAAKAA-100 incendiary bomb, similar to the Russian ZAB-100
0504511



The Iraqi KAAKAA-250 incendiary bomb is based on the Russian ZAB-250
0504512

Russian Federation

Chemical bombs

Note: see also chemical bomblets in the Submunitions entries.

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
KhAB-25 (R-5)	28 kg	12.7 kg HL	0.88 m	203 mm	Nose, impact	single	no longer in service	Mustard gas
KhAB 100 kg (80)	80 kg	28 kg HL	1.1 m	337 mm	Nose, impact	single	no longer in service	Filling mixture of Mustard and Lewisite (HL)
KhAB 100 kg	100 kg	39 kg HL	1.12 m	300 mm	Nose, impact	single	no longer in service	Filling mixture of Mustard and Lewisite (HL)
KhAB-200 (R-5)	159–164 kg	80 kg	2.16 m	320 mm	Nose, airburst	250 mm	no longer in service	War gas no 5
KhAB-200 (R-10)	159–174 kg	90 kg	2.16 m	320 mm	Nose, impact	250 mm	no longer in service	War gas no 10
KhAB 250 kg	233 kg	49 kg GB	1.75 m	375 mm	Nose, impact	single and 250 mm	no longer in service	Filling Sarin nerve agent
KhAB-500 (R-5)	300 kg	175 kg	2.4 m	450 mm	Nose, airburst	250 mm	no longer in service	Diphosgene and war gas no 5
KRAB-25YAD	34 kg	2.7 kg	0.88 m	203 mm	Nose, impact	single	no longer in service	Toxic smoke

The KAB-500Kr-OD is the FAE version of the KAB-500Kr (FSUE Region)
0572201

Russian Federation (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
AK-2	n/k	240 × 1 kg	n/k	n/k	Pilot command	n/k	no longer in service	Dispenser weapon, bomblets are filled with mustard gas and Lewisite
KhAB-100 (R-5)	93 kg	68 kg	n/k	n/k	Nose, impact	250 mm	no longer in service	Filled with war gas no 5
KhAB-500 (R-10)	300 kg	175 kg	2.4 m	450 mm	Nose, impact	250 mm	no longer in service	Filled with war gas no 10
VAP-200	200 kg	Toxic B Agents	n/k	n/k	Pilot command	n/k	no longer in service	Aircraft-mounted spray tank
VAP-1000	1,000 kg	700 l Hydrogen Cyanide	n/k	n/k	Pilot command	n/k	no longer in service	Aircraft-mounted spray tank

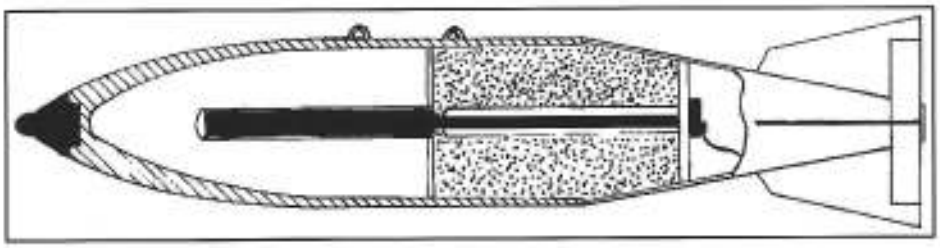
Fuel-air explosive bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
ODAB-500PM	520 kg	193 kg high energy fuel	2.28 m	500 mm	Nose, electronic, contact	250 mm	in service	See Note
ODAB-500PMV	525 kg	193 kg high energy fuel	2.38 m	500 mm	Nose, electronic, contact	250 mm	in service	See Note
KAB-500Kr-OD	460 kg	280 kg fuel	3.05 m	350 mm	n/k	250 mm	in service	TV guided. Similar to KAB-500 Kr
KAB-1500Kr-OD	1,525 kg	650 kg fuel	4.63 m	580 mm	n/k	250 mm	in service	Electro-optical guidance

Note: Fuzes deploy a 'plummet' switch on the end of a length of cable. Other types of ODAB fuel-air bombs are known to exist.

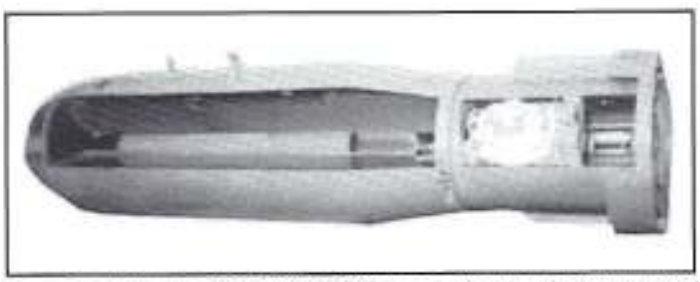
Incendiary bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
FOZAB-500	450 kg	incendiary agent and HE	1.5 m	450 mm	Nose, type n/k	250 mm	in service	Also has limited fragmentation effect



Cross-section of the FZAB-500 HEI bomb. The front section is filled with Torpex HE and the rear with an incendiary composition
0051984

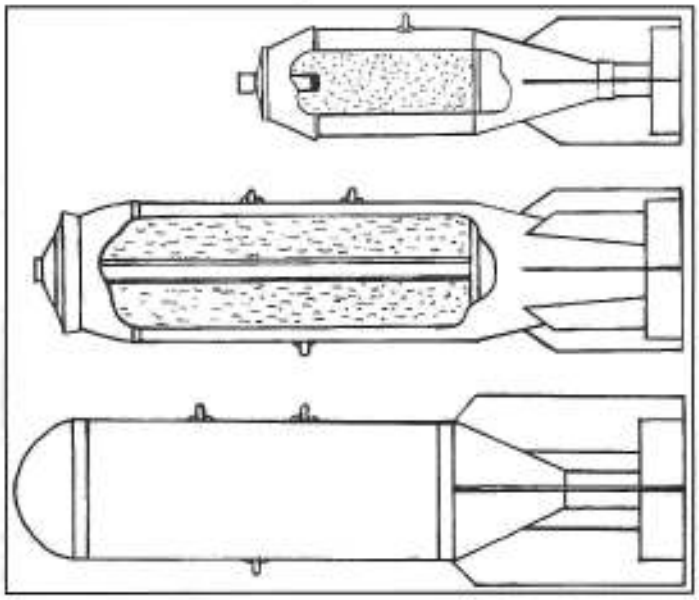
A burnt-out Russian ZAB-500. Note the hooks on the front, used for the attachment of the fuzing system and nose cone (Colin King) 0074280



A sectioned Russian ODAB-500PM FAE bomb, showing the large central HE burster and parachute. Other smaller HE burster tubes are spaced around the central charge. The cloud detonator is in the centre of the tail, behind the parachute (SRPE Bazalt) 0006383

Russian Federation (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
FZAB-500	500 kg	200 kg	2.5 m	450 mm	Tail, type n/k	250 mm	in service	Penetrating HEI bomb
NOSAB-100	100 kg	n/k	1.5 m	240 mm	n/k	250 mm	in service	Signal bomb
OFZAB-500	500 kg	37.5 kg HE and 255 kg incendiary	2.38 m	450 mm	Nose, impact or proximity	250 mm	in service	Fragmentation HEI bomb
ZAB-100-105	106 kg	47 kg incendiary agent	1.06	273 mm	n/k	single point	in service	
ZAB-250	250 kg	incendiary agent	1.51 m	325 mm	n/k	250 mm and single point	in service	
ZAB-250-200	202 kg	68 kg incendiary agent	1.5 m	325 mm	n/k	250 mm and single point	in service	
ZAB-500T	500 kg	incendiary agent	n/k	n/k	Nose, type n/k	n/k	in service	
ZAB-1000	1,000 kg	incendiary agent	n/k	n/k	n/k	n/k	in service	
ZB-500GD	256–343 kg	216–303 kg incendiary agent	2.5 m	500 mm	Central, impact, all-ways acting	250 mm	in service	
ZB-500ShM	317.5 kg	260 kg incendiary agent	2.5 m	500 mm	Central, impact, all-ways acting	250 mm	in service	



Russian incendiary bombs. From the top: ZAB-100-105, ZAB-250-200, ZAB-250
0051974

Serbia

Incendiary bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
PLAB-150	n/k	150 litres napalm	n/k	n/k	*Note 1*	n/k	in service	*Note 2*
PLAB-200	n/k	200 litres napalm	n/k	n/k	*Note 1*	n/k	in service	*Note 2*
PLAB-350	n/k	420 litres napalm	n/k	n/k	*Note 1*	n/k	in service	*Note 2*

Note 1: Likely to contain nose and tail fuzes with all-ways acting mechanisms and white phosphorus igniters.
Note 2: Appear to be based on the design of early US fire bombs.

Spain

Incendiary bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BIN-100	100 kg	napalm	1.9 m	280 mm	see Note	250 or 356 mm	in service	Similar to early US napalm bomb

Spain (continued)

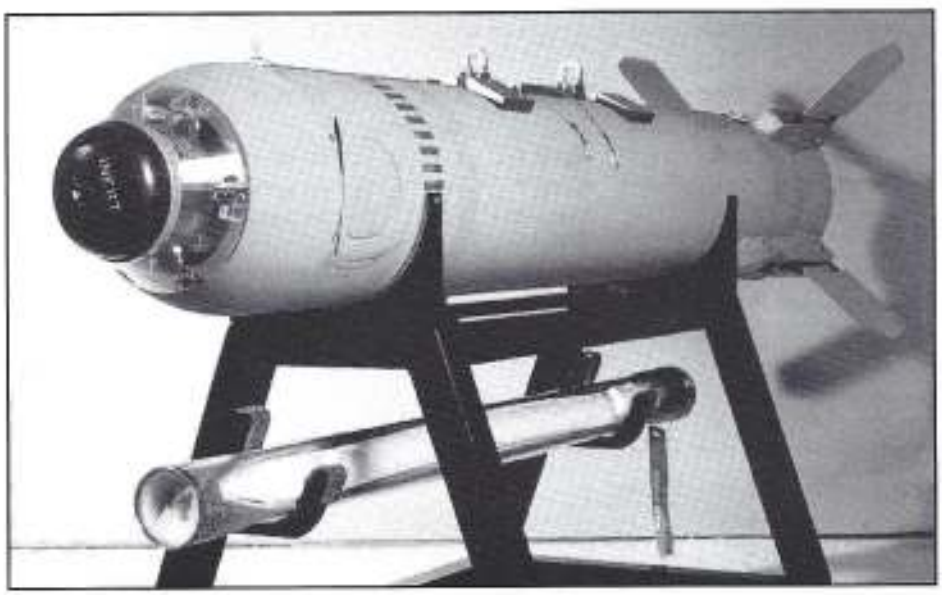
Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BIN-250	250 kg	napalm	2.47 m	446 mm	see Note	250 or 356 mm	in service	Similar to early US napalm bomb
BIN-375	375 kg	napalm	3.23 m	446 mm	see Note	250 or 356 mm	in service	Similar to early US napalm bomb

Note: Two side-mounted mechanical EMBI fuzes with all-ways acting mechanisms.

United States

Chemical bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BLU-50/B	n/k	BZ incapacitant	n/k	n/k	n/k	n/k	no longer in service	Chemical warfare bomb
BLU-52/B	317 kg	279 kg CS gas	n/k	n/k	n/k	n/k	no longer in service	Chemical warfare bomb
BLU-80 Bigeye	227 kg	VX chemical nerve agent	n/k	n/k	n/k	356 mm	no longer in service	Binary weapon
CBU-15/A	n/k	BLU-19/B23 chemical bomblets	n/k	n/k	n/k	356 mm	no longer in service	Chemical warfare cluster bomb that uses an SUU-31/A dispenser
CBU-19/A	n/k	16 × 33 BLU-39/B CS gas bomblets	n/k	n/k	n/k	356 mm	no longer in service	Chemical warfare cluster bomb
CBU-30/A	n/k	40 × 30 BLU-39/B CS gas bomblets	n/k	n/k	n/k	356 mm	no longer in service	Chemical warfare cluster bomb using an SUU-13/A dispenser
M70A1	55.6 kg	25.9 kg persistent mustard gas	n/k	n/k	n/k	356 mm	no longer in service	
M78	227 kg	various non-persistent chemicals	n/k	n/k	n/k	356 mm	no longer in service	
M79	435.5 kg	non-persistent AC, CK or CG	n/k	n/k	n/k	356 mm	no longer in service	
M113	55.7 kg	unspecified	n/k	n/k	n/k	356 mm	no longer in service	
MC1	3,296 kg	100 kg of Sarin nerve gas	n/k	n/k	Nose/tail, impact	356 mm	no longer in service	Modified M117 bomb



BLU-80 'Bigeye' binary chemical bomb (USN)
0006408

United States (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
Mk 94	227 kg	Mk 82 GP filled with 49 kg of Sarin nerve gas	n/k	n/k	Nose/tail, impact	356 mm	no longer in service	Modified Mk 82 bomb
Mk 116 Weteye	340 kg	182.8 kg of Sarin nerve gas	n/k	n/k	n/k	356 mm	no longer in service	

Fuel-air explosive bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BLU-64/B	350 kg	200 kg Hydrocarbon fuel	n/k	n/k	n/k	356 mm	n/k	See Note
BLU-72/B Pave Pat	1,134 kg	1,018 kg of Propane	n/k	n/k	n/k	n/k	n/k	See Note
BLU-72/B Pave Pat 2	1,202 kg	Ethylene Oxide	n/k	n/k	n/k	n/k	in service	Designed for high-speed delivery
BLU-95/B	227 kg	136 kg Propylene Oxide	n/k	n/k	n/k	356 mm	in service	USAF designation: High-Speed FAE No 1
BLU-96/B	907 kg	635 kg Propylene Oxide	n/k	n/k	n/k	356 mm	in service	USAF designation: High-Speed FAE No 2. Reportedly used as a payload for GBU-15 bomb
BLU-73/B bomblet	45 kg	33 kg Ethylene Oxide	0.53 m	340 mm	Contact probe	n/a	in service	Three bomblets carried by CBU-55/B and CBU-72

Note: Combat tested in 1967/68 but is thought not to have entered general service.

An empty US CBU-55/B casing. This bomb dispenses three 45 kg BLU-73/B FAE bomblets (Colin King)
0074261

Incendiary bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BLU-1	340 kg	340–378 litres napalm	n/k	n/k	*Note 1*	356 mm	n/k	
BLU-10	113 kg	125 litres napalm	n/k	n/k	*Note 1*	356 mm	no longer in service	
BLU-11	227 kg	246 litres napalm	n/k	n/k	*Note 2*	356 mm	no longer in service	

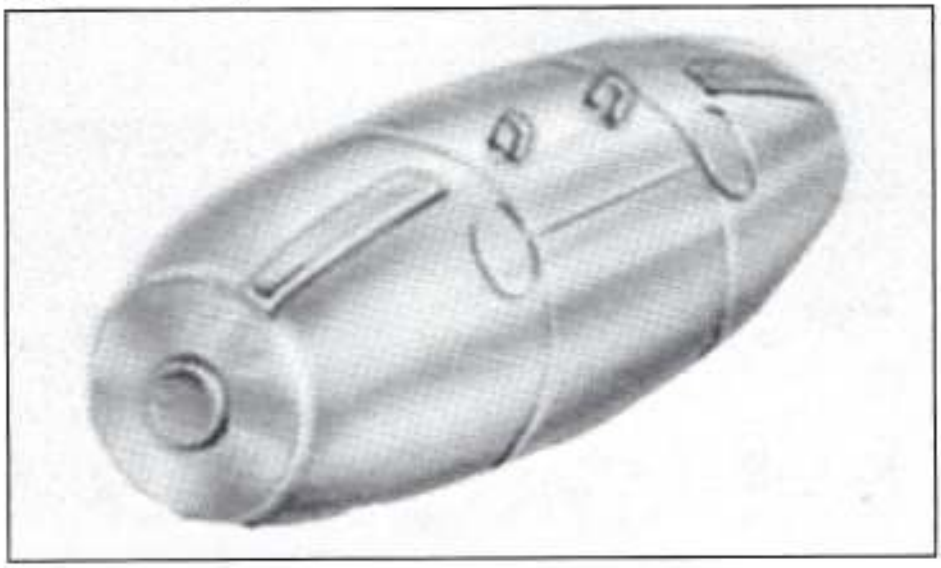
United States (continued)

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
BLU-23/B	227 kg	254 litres napalm	n/k	n/k	*Note 1*	356 mm	no longer in service	
BLU-27	340 kg	379 litres napalm B	n/k	n/k	*Note 1*	356 mm	no longer in service	
BLU-32	227 kg or 268 kg	254 litres napalm B	n/k	n/k	*Note 1*	356 mm	no longer in service	
BLU-35	113 kg	125 litres napalm	n/k	n/k	n/k	356 mm	no longer in service	
BLU-53 (bomblet)	9 kg	napalm B	n/k	n/k	n/k	n/a	no longer in service	For use in dispensers
BLU-65/B	127 kg	n/k	n/k	n/k	n/k	356 mm	no longer in service	
BLU-74	107 kg	napalm B	n/k	n/k	n/k	356 mm	no longer in service	
M-116	340 kg	364 litres of thickened fuel	n/k	n/k	*Note 2*	356 mm	no longer in service	
M70	55.6 kg	25.9 kg White Phosphorus	n/k	n/k	n/k	356 mm	n/k	
Mk 77 Mod 0	340 kg	416 litres of petroleum oil	n/k	n/k	*Note 2*	356 mm	in service	Used in 1990–1991 Gulf War
Mk 77 Mod 1	227 kg	284 litres of petroleum oil	n/k	n/k	*Note 2*	356 mm	no longer in service	
Mk 78	340 kg	416 litres of petroleum oil	n/k	n/k	*Note 2*	356 mm	no longer in service	
Mk 79	454 kg	424 litres of petroleum oil	n/k	n/k	*Note 2* or MK257 impact/ proximity	356 or 762 mm	no longer in service	
Mk 122 Fireye	n/k	new filling	n/k	n/k	n/k	n/k	no longer in service	

Note 1: Nose and tail fuzes are FMU-7 mechanical all-ways acting, with white phosphorus igniters.
Note 2: Nose and tail fuzes are M157 or M173 mechanical all-ways acting, with white phosphorus igniters.

Nuclear bombs

Designation	Weight	Filling	Length	Body diameter	Fuzing	Lug spacing	Status	Remarks
B57	230 kg	fission material	3.0 m	380 mm	various options	356 mm or 762 mm	no longer in service	5–10 kT yield
B61	326–347 kg	Oralloy, Lithium Deuteride and Tritium. PBX HE	3.6 m	340 mm	n/k	356 mm or 762 mm	in service	10 or 100–500 kT yield
B83	1,088 kg	Plutonium/ Oralloy. PBX HE	3.66 m	460 mm	n/k	762 mm	in service	1–2 MT yield
B90	800 kg	n/k	3.0 m	330 mm	n/k	762 mm	n/k	10–20 MT yield



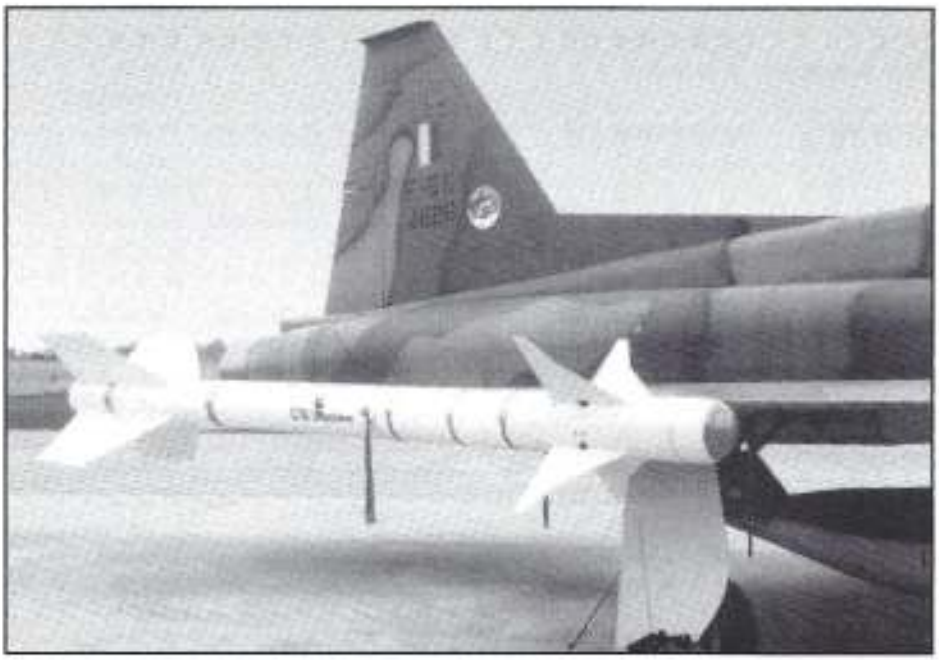
Drawing of the US Mk 77 incendiary bomb
0006410

AIR-TO-AIR MISSILES

Brazil

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
MAA-1 (Piranha)	2.75 m	152 mm	89 kg	12 kg pre-fragmentated. HMX charge	Active laser proximity	IR	solid	in service	Similar to AIM-9 Sidewinder



MAA-1 'Piranha' (Mectron)
0130527

China

Short range lightweight
(Based on a man-portable system)

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
HN-5	1.44 m	72 mm	10 kg	1.8 kg fragmentation	impact	IR	solid	n/k	Similar to SA-7 'Grail'
QW-1	1.53 m	70 mm	10.7 kg	1.5 kg fragmentation	impact	IR	solid	in service	Similar appearance to FIM-92 'Stinger'
QW-2	1.59 m	72 mm	11.32 kg	1.42 kg HE	active laser proximity	IR	solid	in service	Larger motor than QW-1

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
PL-1	2.5 m	200 mm	83 kg	15 kg HE	RF	radar beam	solid	obsolescent	Operational since 1964
PL-2	2.99 m	127 mm	76 kg	11.3 kg blast/ fragmentation	IR	IR	solid	in service	Chinese version of Russian AA-2
PL-3	2.99 m	127 mm	82 kg	13.5 kg blast/ fragmentation	IR	IR	solid	in service	Improved version of PL-2
PL-5B	2.89 m	127 mm	87 kg	9 kg blast/ fragmentation or continuous rod	IR or RF	IR	solid	in service	Based on US AIM-9B and G Sidewinders

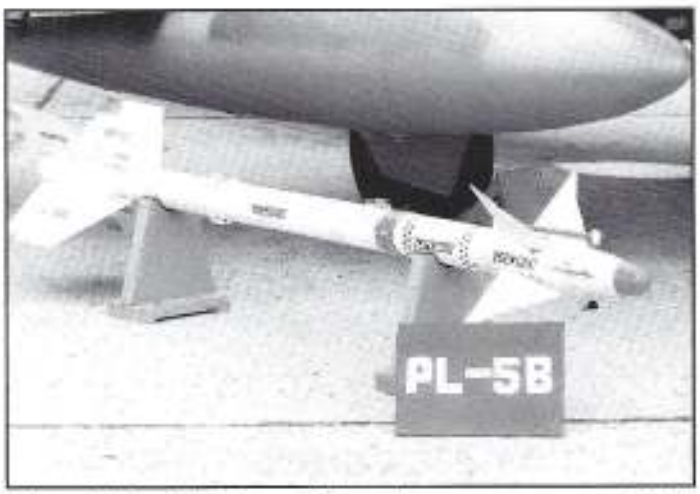
Short range (continued)

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
PL-5E	2.89 m	127 mm	83 kg	9 kg HE	active laser proximity	IR	solid	in service	Similar to US AIM-9L/M Sidewinder
PL-7	2.75 m	158 mm	90 kg	12 kg fragmentation	IR	IR	solid	in service	Similar to French R550 Magic 1
PL-7B	2.75 m	158 mm	93 kg	12 kg fragmentation	IR	IR	solid	in service	Improved version of PL-7
PL-8	3.0 m	160 mm	120 kg	10 kg fragmentation	active laser proximity	IR	solid	in service	Similar to Israeli Python 3
PL-9	2.9 m	157 mm	115 kg	10 kg HE	active laser proximity	IR	solid	in service	PL-9N is naval version
PL-9C	2.9 m	157 mm	115 kg	10 kg HE	active laser proximity	IR	solid	in service	Export version of PL-9
TY-90	1.9 m	90 mm	20 kg	3 kg expanding rod	active laser proximity	IR	solid	entering service	Used on helicopters

Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
PL-10	3.69 m	200 mm	220 kg	fragmentation	RF	semi-active radar	solid	in service	Similar to US AIM-7
PL-12 (SD-10)	3.85 m	203 mm	180 kg	fragmentation	laser proximity	active radar	solid	entering service	SD-10 is export model
LY-60 (PL-11)	3.89 m	208 mm	220 kg	33 kg fragmentation	n/k	semi-active radar	solid	n/k	Similar to US AIM-7 Sparrow

The Chinese PL-9 missile (CATIC) 0022822



Chinese PL-5B missile (Raymond Cheung) 0022821

The Chinese QW-1, which is based on the US FIM-92 Stinger (Duncan Lennox) 0001864

France

Short range lightweight
(Based on a man-portable system)

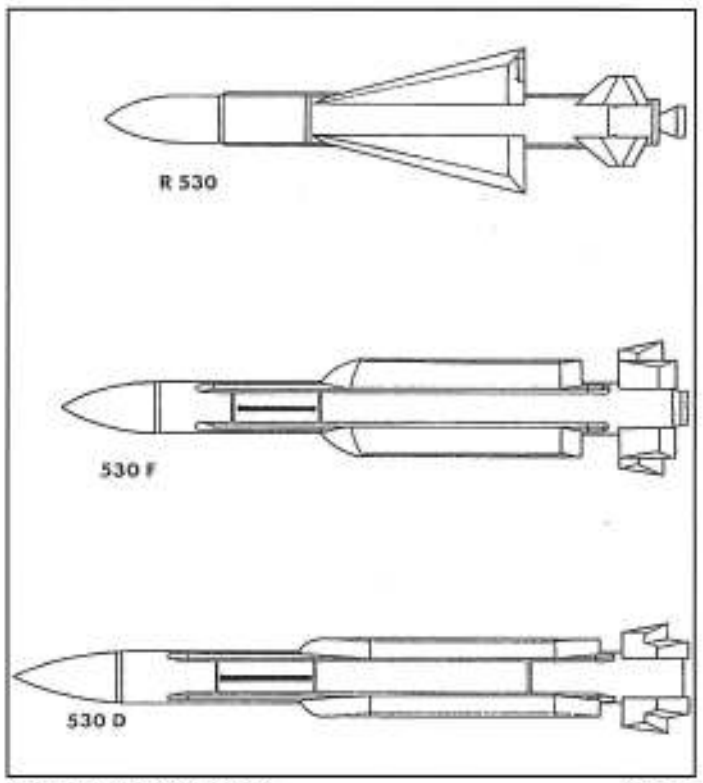
Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Mistral ATAM	1.8 m	90 mm	18 kg	3 kg tungsten ball	active laser proximity	IR	solid	in service	Widely exported

Short range

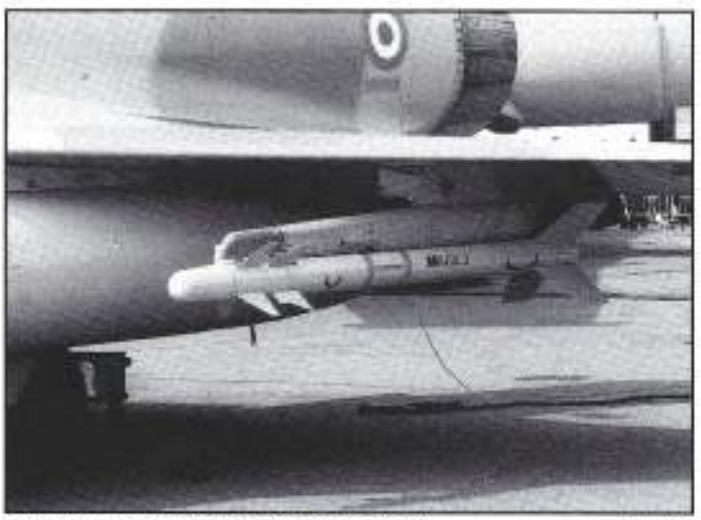
Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
R550 Magic 1	2.72 m	157 mm	89 kg	13 kg fragmentation	IR	IR	solid	in service	Used in the Falklands and Gulf War
R550 Magic 2	2.75 m	157 mm	90 kg	13 kg fragmentation	RF	IR	solid	in service	Used in the Gulf War and Bosnia

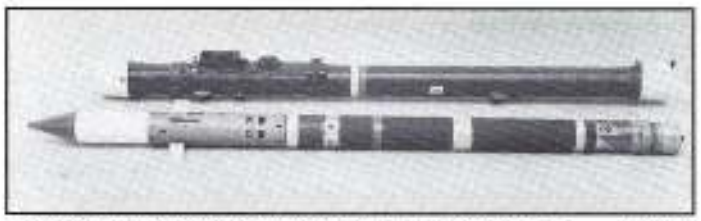
Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
R530	3.28 m	263 mm	195 kg	27 kg fragmentation	RF	semi-active radar or IR	solid	in service	Used by Argentina in the Falklands
530-F Super	3.54 m	263 mm	245 kg	30 kg fragmentation	RF	semi-active radar	solid	in service	Widely exported
530-D Super	3.8 m	263 mm	270 kg	30 kg fragmentation	active radar proximity	semi-active radar	solid	in service	Widely exported
Mica	3.1 m	165 mm	110 kg	12 kg blast/ fragmentation	active radar proximity	command, inertial and active radar or IR	solid	in service	Widely exported



Variants of the R 530 missile 0504827

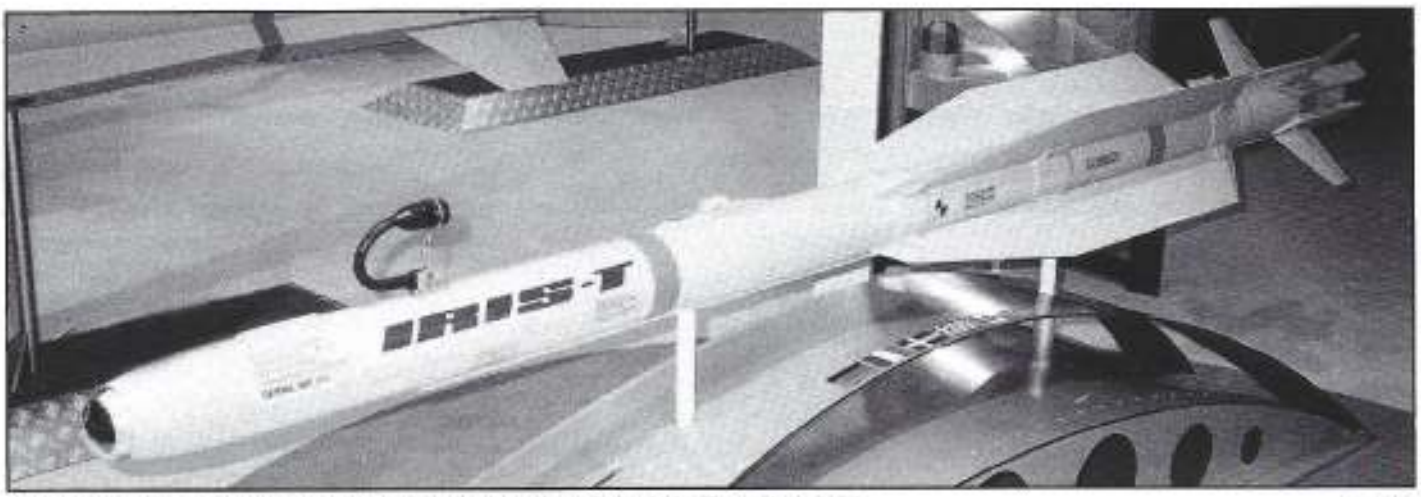

The French Magic-2 missile (Duncan Lennox) 0062621


The Mistral 1 missile (rear wings folded) and launcher tube 0504829

Germany

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
IRIS-T	3.0 m	127 mm	87 kg	11.4 kg fragmentation	active laser proximity	Imaging IR	solid	entering service 2004	May use 'Sidewinder' warheads and fuzes



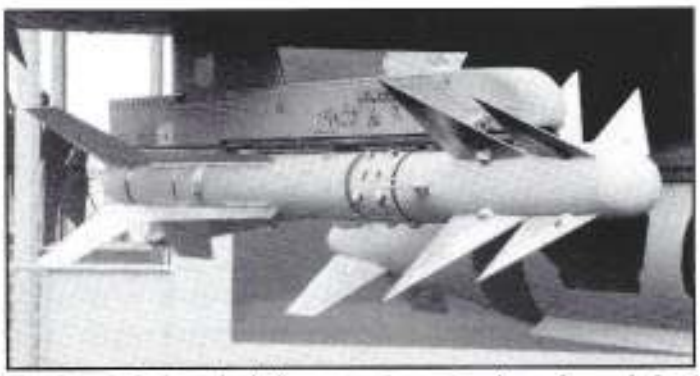
The German IRIS-T missile can use warheads and fuzes from Sidewinder (Peter Humphris) 0062622

Israel

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Shafrir 2	2.6 m	160 mm	95 kg	11 kg fragmentation	impact and proximity	IR	solid	In service	Similar to US AIM-9B Sidewinder
Python 3	3.0 m	160 mm	120 kg	11 kg fragmentation	impact and active radar proximity	IR	solid	In service	Manufactured in China as PL-8
Python 4	3.0 m	160 mm	104 kg	11 kg fragmentation	active laser proximity	IR	solid	In service	Exported to Chile
Python 5	3.1 m	160 mm	104 kg	11 kg fragmentation	active laser proximity	IR	solid	entering service	Based on Python 4

The Israeli 'Derby' missile 0130548



The Israeli Python 4 missile; note the active laser fuze windows behind the forward fins. Python 5 uses the same airframe (Duncan Lennox) 0103989

Medium range

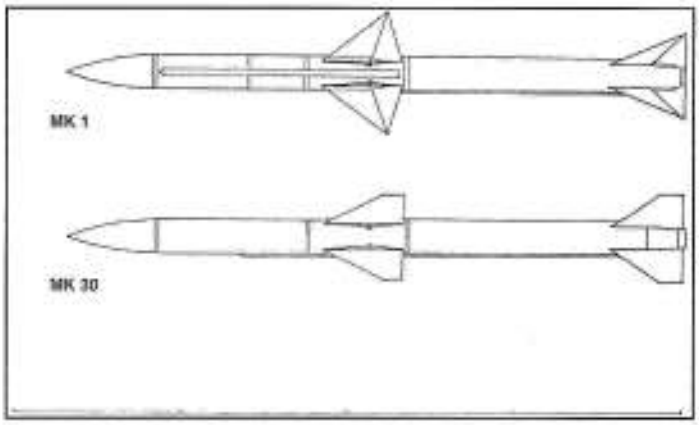
Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Derby	3.62 m	160 mm	118 kg	Fragmentation	Proximity	Active radar	solid	In service	Also known as 'Python 5'. Exported to Chile

Italy

Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Aspide 1	3.7 m	203 mm	220 kg	30 kg fragmentation	active radar proximity	semi-active radar	solid	in service	Based on US AIM-7E Sparrow. Widely exported
Aspide 2000 or 'Mk 30'	3.7 m	234 mm	225 kg	30 kg fragmentation	active radar proximity	semi-active radar	solid	in service	Replaced the terminated 'Aspide 2'

Note: Ship and ground-launched versions of Aspide 1 are also in service.

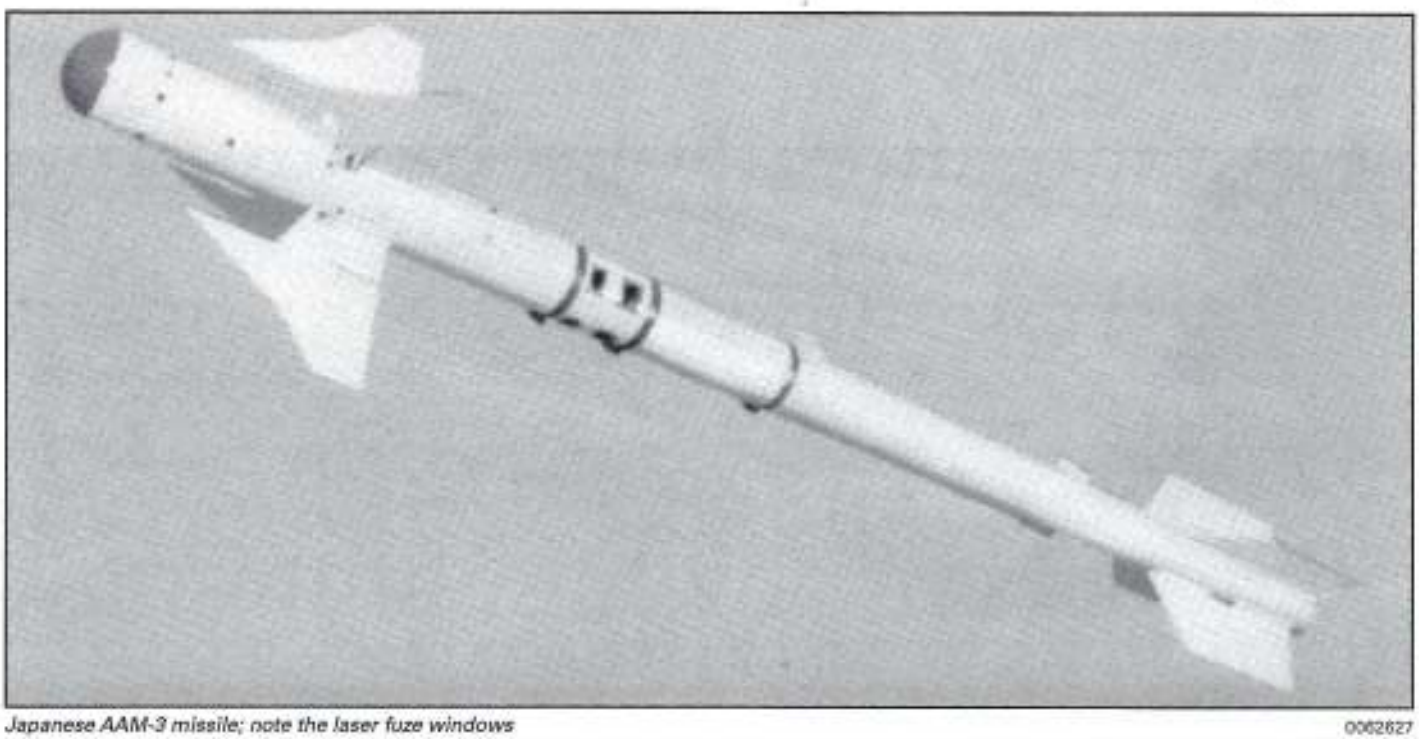


Variants of the Aspide missile
0504946

Japan

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AAM-3 (Type 90)	3.0 m	127 mm	91 kg	15 kg fragmentation	Active laser proximity	IR	solid	in service	Similar to US AIM-9 'Sidewinder'
AAM-4 (Type 99)	3.7 m	200 mm	220 kg	HE frag; weight n/k	Active radar	Inertial, semi-active radar	solid	entering service	Similar to the AIM-7 Sparrow in size and appearance



Japanese AAM-3 missile; note the laser fuze windows
0062627

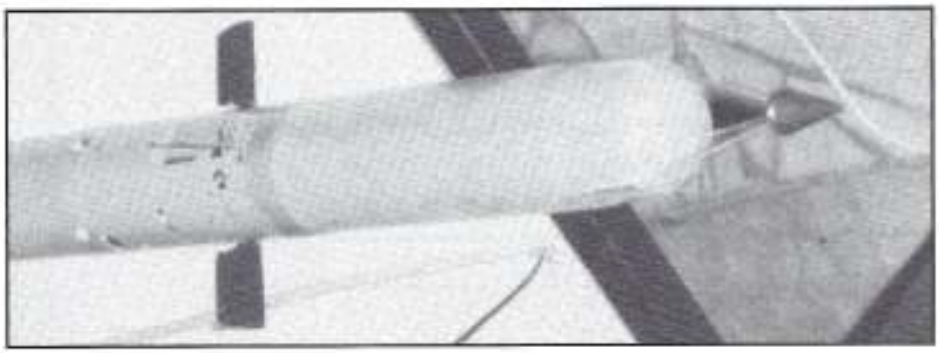
Russian Federation

Short range lightweight

(Based on a man-portable system)

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
SA-7a 'Grail' (9M32)	1.42 m	72 mm	9.2 kg	1.2 kg fragmentation	impact	IR	solid	in service	See note
SA-7b 'Grail' (9M32)	1.44 m	72 mm	10 kg	1.8 kg fragmentation	impact	IR	solid	in service	See note
SA-14 'Gremlin' (9M36)	1.47 m	72 mm	10.5 kg	2 kg fragmentation	impact	IR	solid	in service	Battery incorporates gas bottle
SA-16 'Gimlet' (9M313)	1.69 m	72 mm	10.8 kg	2 kg fragmentation	impact	IR	solid	in service	Conical nose spike
SA-18 'Grouse' (9M39)	1.69 m	72 mm	10.8 kg	2 kg fragmentation	impact	IR	solid	in service	Straight nose spike

Note: these missiles are very widely used, license-produced and copied.



The distinctive conical nose spike on the Russian SA-16 (Christopher F Foss)
0022852

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AA-2 'Atoll-A' (R-3S)	2.84 m	127 mm	75 kg	11.3 kg HE/frag	contact	IR	solid	in service	Widely exported
AA-2 'Atoll-B' (R-3R)	3.42	127 mm	82 kg	11.3 kg HE/frag	contact and radar proximity	semi-active radar	solid	in service	Widely exported
AA-2 'Atoll-C' (R-13M)	2.87 m	127 mm	88 kg	11.3 kg blast/ fragmentation	contact	IR	solid	in service	Similar to the US AIM-9D and E Sidewinders. Widely exported

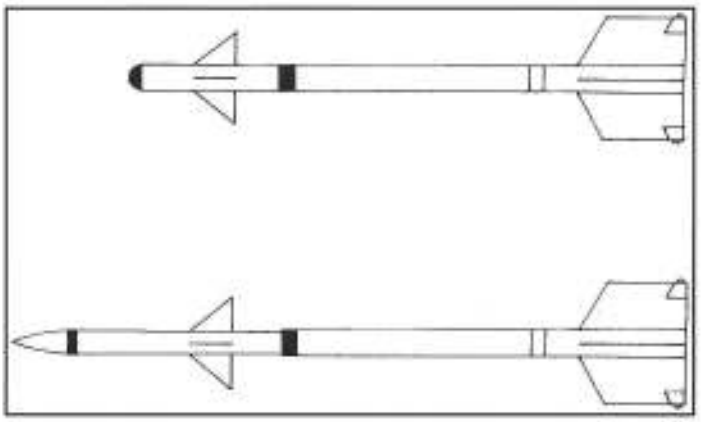
AA-8 has a warhead containing 1.6 kg of depleted Uranium (Colin King)
0567410

Short range (continued)

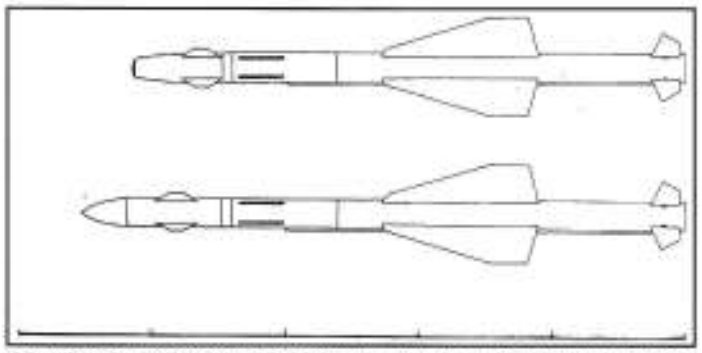
Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AA-8 'Aphid' (R-60)	2.08 m	130 mm	63 kg	3 kg fragmentation, with 1.6 kg of depleted Uranium	active radar proximity	IR	solid	in service	Replaced AA-2. Widely exported
AA-8 'Aphid' (R-60M)	2.09 m	120 mm	43 kg	3.5 kg rod	active laser proximity	IR	solid	in service	Upgraded AA-8. Widely exported

Medium range

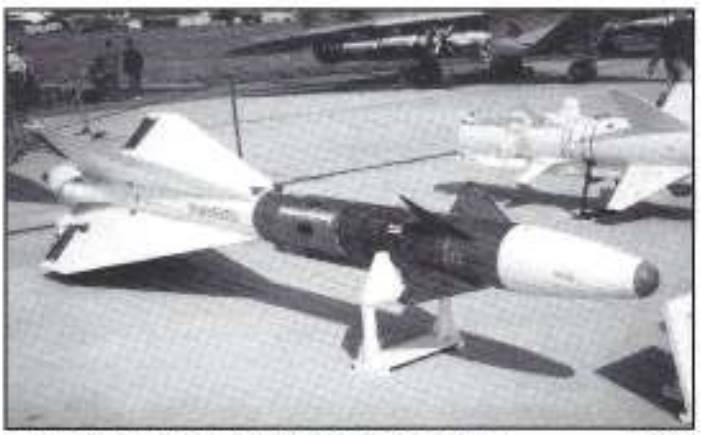
Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AA-3 'Anab' (R-98R)	3.6 m	220 mm	300 kg	40 kg blast	n/k	semi-active radar	solid	in service	*Note 1*
AA-3 'Anab' (R-98T)	3.3 m	220 mm	300 kg	40 kg blast	n/k	IR	solid	in service	*Note 1*
AA-5 'Ash' (R-4R)	5.25 m	300 mm	483 kg	54 kg blast	n/k	semi-active radar	solid	in service	*Note 1*
AA-5 'Ash' (R-4T)	5.16 m	300 mm	483 kg	54 kg blast	n/k	IR	solid	in service	*Note 1*
AA-6 'Acrid' (R-40R)	6.2 m	355 mm	472 kg	55 kg fragmentation	active radar and laser proximity	command, inertial and semi-active radar	solid	in service	Limited exports up until 1996
AA-6 'Acrid' (R-40T)	6.2 m	355 mm	467 kg	35 kg fragmentation	active radar and laser proximity	command, inertial and IR	solid	in service	Limited exports up until 1996
AA-7 'Apex' (R-24R)	4.46 m	200 mm	235 kg	35 kg fragmentation	active radar proximity	command and semi-active radar	solid	in service	*Note 2*



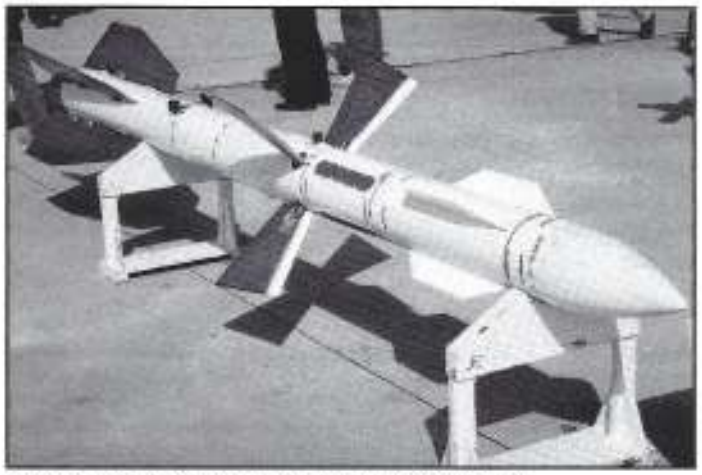
AA-2 missiles: Atoll-A (above) and Atoll-B (below) 0504290



AA-7 'Apex' missiles: IR-guided (above) and radar-guided (below) 0022838



The Russian AA-6 'Acrid' missile (Christopher F Foss) 0001882

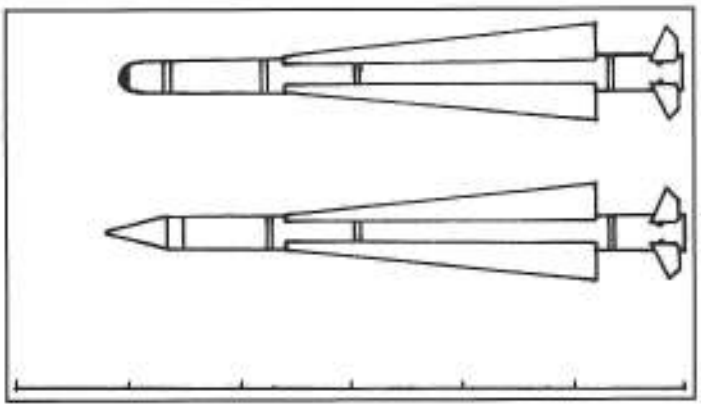


A Russian AA-10 'Alamo' medium-range missile (R-27R) (Christopher F Foss) 0022844

Medium range (continued)

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AA-7 'Apex' (R-24T)	4.16 m	200 mm	235 kg	35 kg fragmentation	active radar proximity	command and IR	solid	in service	*Note 2*
AA-10 'Alamo' (R-27T)	3.8 m	230 mm	254 kg	33 kg expanding rod	active radar proximity	inertial, command and IR	solid	in service	*Note 2*
AA-10 'Alamo' (R-27R)	4 m	230 mm	253 kg	33 kg expanding rod	active radar proximity	inertial, command and semi-active radar	solid	in service	*Note 2*
AA-10 'Alamo' (R-27ET)	4.5 m	260 mm	343 kg	39 kg expanding rod	active radar proximity	inertial, command and IR	solid	in service	*Note 2*
AA-10 'Alamo' (R-27ER)	4.7 m	260 mm	350 kg	39 kg expanding rod	active radar proximity	inertial, command and semi-active radar	solid	in service	*Note 2*
AA-10 'Alamo' (R-27AE)	4.78 m	260 mm	350 kg	39 kg expanding rod	active radar proximity	inertial, command and active radar	solid	in service	*Note 2*
AA-10 'Alamo' (R-27P)	3.8 m	230 mm	245 kg	33 kg expanding rod	active radar proximity	inertial and passive RF	solid	in service	*Note 2*
AA-11 'Archer' (R-73)	2.9 m	170 mm	105 kg	7.4 kg fragmentation	active radar proximity	IR	solid	in service	*Note 2*
AA-11 'Archer' (R-73M2)	2.9 m	170 mm	110 kg	7.4 kg fragmentation	active radar proximity	IR	solid	in service	*Note 2*
AA-12 'Adder' (R-77)	3.6 m	200 mm	180 kg	22.5 kg fragmentation	active laser proximity and impact	inertial, command and active radar	solid	in service	Few exports

Note 1: Mainly used by former Warsaw Pact countries.
Note 2: Widely used and exported.



Russian AA-5 'Ash' missile shapes:
R-4T (IR) above;
R-4R (Radar) below
0022840

Long range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AA-9 'Amos' (R-33)	4.15 m	380 mm	491 kg	55 kg HE	active radar proximity	inertial, command and semi-active radar	solid	in service	Limited use and export
AA-10 'Alamo' (R-27EM)	4.78 m	260 mm	350 kg	39 kg expanding rod	active radar proximity	inertial, command and semi-active radar	solid	in service	Widely exported
AAM-L (KS-172)	7.4 m	n/k	750 kg	50 kg fragmentation	n/k	inertial and active radar	solid	uncertain	

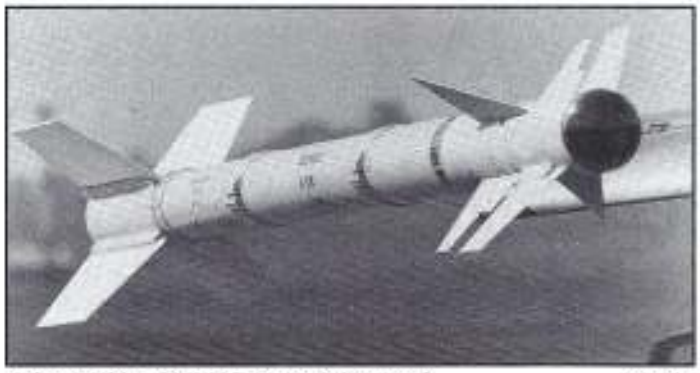
South Africa

Short range

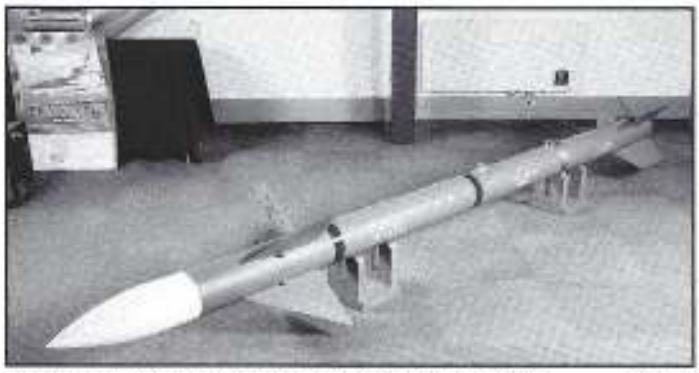
Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
A-Darter V3E	2.98 m	166 mm	89 kg	fragmentation	contact and active laser proximity	inertial and imaging IR	solid	uncertain	
Darter V3C	2.75 m	157 mm	90 kg	17 kg Tungsten fragmentation, RDX-based charge	contact and active laser proximity	IR	solid	in service	
U-Darter	2.75 m	160 mm	96 kg	17 kg fragmentation	contact and active laser proximity	IR	solid	in service	Upgraded version of V3C
V3A, V3B 'Kukri'	2.94 m	127 mm	74 kg	fragmentation, Torpex charge	IR	IR	solid	no longer in service	Similar appearance to French 'Magic'

Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
SAHV-RS (MRAAM)	3.6 m	180 mm	140 kg	n/k	n/k	inertial and active radar	solid	uncertain	
V4 R-Darter, T-Darter	3.6 m	160 mm	120 kg	fragmentation	proximity	inertial and active radar	solid	in service	Similar to Israeli 'Derby'



A South African V3B 'Kukri' missile (Kentron) 0022855



Active radar version of the South African R-Darter missile 0130625

The short-range A-Darter missile (Kentron) 0062628

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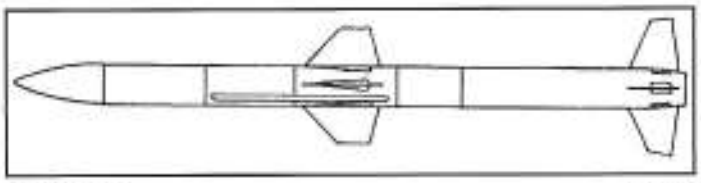
Taiwan

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Sky Sword 1 (Tien Chien I)	2.87 m	127 mm	90 kg	Approx 10 kg (est), fragmentation or expanding rod	active laser proximity and impact	IR	solid	in service	Very similar to US AIM-9L 'Sidewinder'

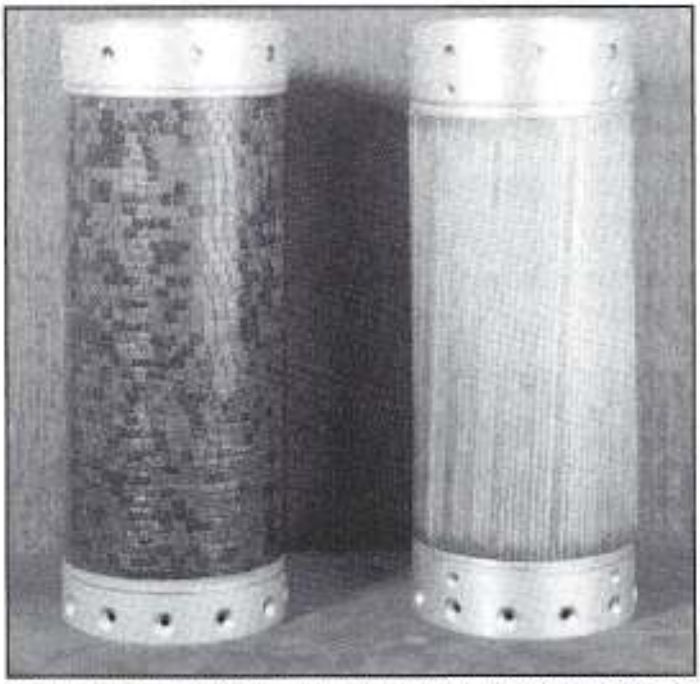
Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Sky Sword 2 (Tien Chien II)	3.6 m	190 mm	183 kg	22 kg blast/ fragmentation	active radar proximity	semi-active radar	solid	entering service	Similar to US AIM-120 AMRAAM



Sky Sword 2 0504703

Sky Sword 1 missile 0130630



The optional fragmentation and expanding rod warheads available for Sky Sword 1 (CSIST) 0130628

United Kingdom

Short range lightweight
(Based on a man-portable system)

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	In service
Starstreak 'ATASK' (Helstreak)	1.4 m	130 mm	16 kg	three darts, each with HE frag warhead. See Note	impact	radio command and laser grid	solid	entering service	SAM version already in service

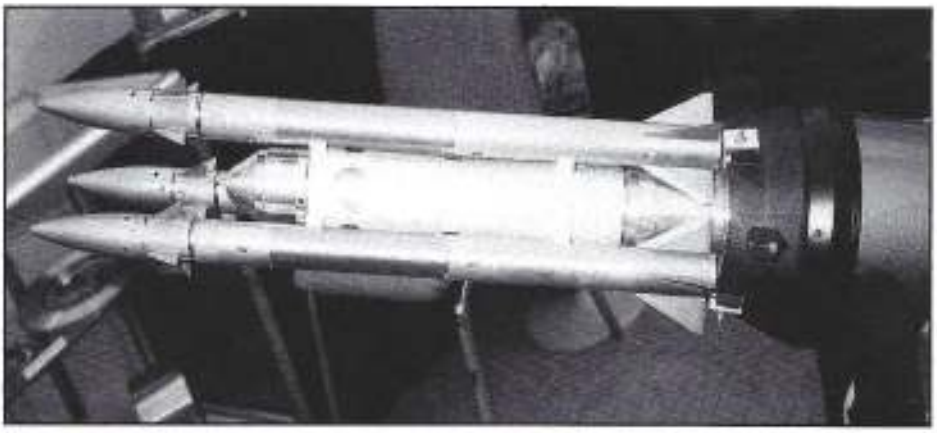
Note: Darts are 396 mm long, 22 mm diameter and weigh 0.9 kg; each contains a small HE fragmentation warhead and impact fuze.

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
ASRAAM	2.9 m	166 mm	87 kg	blast/ fragmentation	active laser proximity	imaging IR	solid	in service	Used by the UK in Iraq

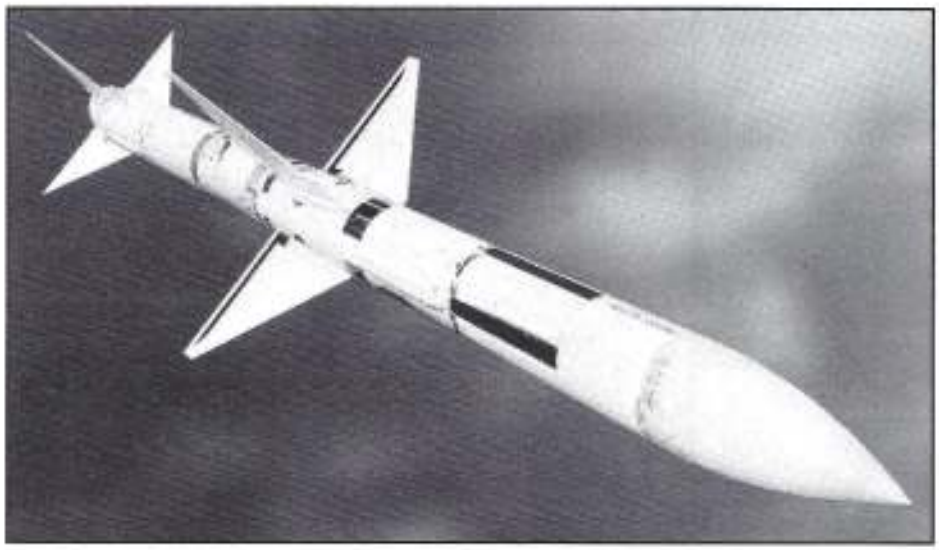
Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Sky Flash	3.66 m	203 mm	195 kg	30 kg continuous rod	active radar proximity	semi-active radar	solid	in service	Very similar to US AIM-7 'Sparrow'



The three darts that form the warhead of the UK Starstreak missile; each has an impact fuze and a small HE charge
(Peter Humphris)
0062633

The ASRAAM missile
(Duncan Lennox)
0062631



Sky Flash was based on the US AIM-7 'Sparrow'
0604311

United States

Short range lightweight
(Based on a man-portable system)

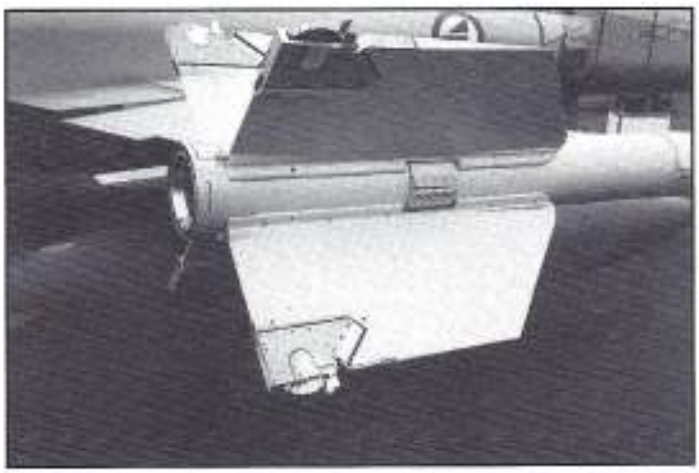
Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
FIM-92 Stinger	1.52 m	70 mm	16 kg	3 kg fragmentation	impact	IR	solid	in service	Widely exported, used in Afghanistan

Short range

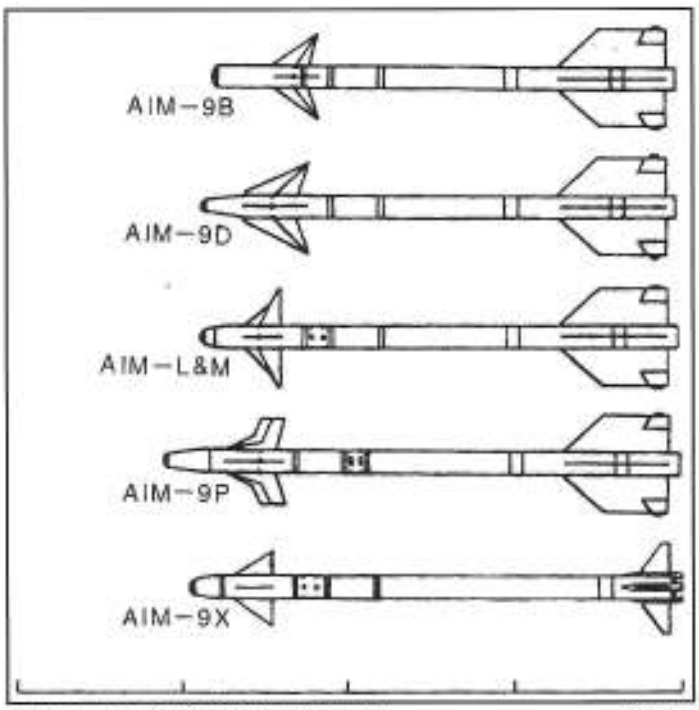
Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AIM-4D Falcon	2.02 m	165 mm	61 kg	12 kg HE	active radar proximity	IR	solid	obsolete	Operational 1963
AIM-26B Falcon	2.13 m	292 mm	115 kg	18 kg HE	active radar proximity	semi-active radar	solid	obsolete	Operational 1963
AIM-9B Sidewinder	2.83 m	127 mm	76 kg	4.5 kg blast/ fragmentation	IR	IR	solid	in service	*Note 1*
AIM-9D Sidewinder	2.87 m	127 mm	90 kg	9 kg continuous rod	RF	IR	solid	in service	*Note 1*
AIM-9L Sidewinder	2.87 m	127 mm	87 kg	9.5 kg blast/ fragmentation	active laser proximity	IR	solid	in service	*Note 1*
AIM-9M Sidewinder	2.9 m	127 mm	86 kg	10.15 kg blast/ fragmentation	active laser proximity	IR	solid	in service	*Note 1*
AIM-9P Sidewinder	3.07 m	127 mm	92 kg	12 kg blast/ fragmentation	RF or laser	IR	solid	in service	*Note 1*
AIM-9R Sidewinder	2.87 m	127 mm	87 kg	9.5 kg blast/ fragmentation	active laser proximity	visual	solid	terminated	*Note 1*
AIM-9S Sidewinder	2.87 m	127 mm	86 kg	10.15 kg blast/ fragmentation	active laser proximity	IR	solid	in service	*Note 1*
AIM-9X Sidewinder	3.1 m	127 mm	84 kg	HE fragmentation	active laser proximity	IR	solid	entering service	

Note 1: Sidewinder variants have been exported extensively and were used in Vietnam, the Falklands and the Gulf War. The designs have been widely copied and some variants have been manufactured under license. Early variants may still be in service with some countries.

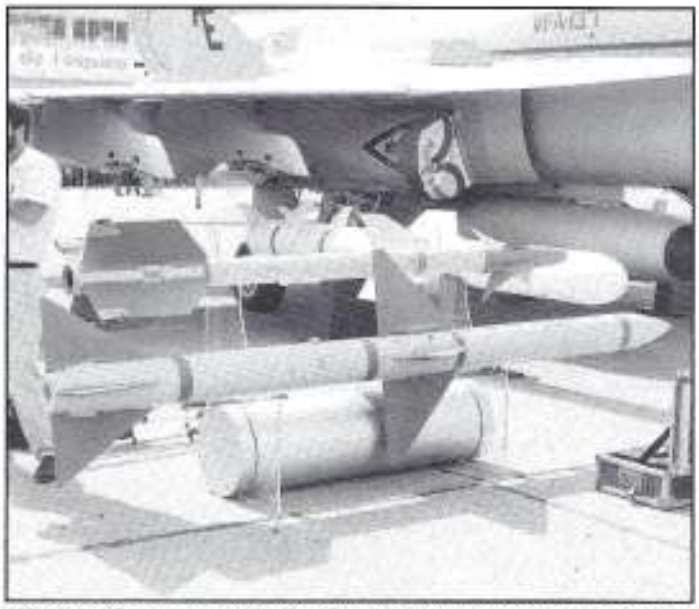
Nose section of the US AIM-9L; note the laser fuze windows behind the fins (Peter Humphris) 0504835



Tail section of the US AIM-9L (Peter Humphris) 0504836



Various types of US 'Sidewinder' missile 0022868



US AIM-7 'Sparrow' missile (front) with an AIM-9M 'Sidewinder' behind (Duncan Lennox) 0504490

US FIM-92 'Stinger' missile 0504494

The AIM-120 'AMRAAM' missile (Raytheon) 0022862

Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AIM-7F Sparrow	3.66 m	203 mm	227 kg	39 kg continuous rod	RF	semi-active radar	solid	in service	*Note 2*
AIM-7M Sparrow	3.66 m	203 mm	230 kg	39 kg blast/ fragmentation	active radar proximity	semi-active radar	solid	in service	*Note 2*
AIM-7P Sparrow	3.66 m	203 mm	230 kg	39 kg blast/ fragmentation	active radar proximity	command and semi-active radar	solid	in service	*Note 2*
AIM-7R Sparrow	3.66 m	203 mm	230 kg	39 kg blast/ fragmentation	active radar proximity	command, semi-active radar and IR	solid	in service	*Note 2*
AIM-120 AMRAAM	3.65 m	178 mm	157 kg	22 kg directed fragmentation	impact and active radar proximity	command, inertial and active radar	solid	in service	Widely exported. Used in the Gulf and the Balkans

Note 2: Sparrow variants have been widely exported. Early versions were used in Vietnam, and more recent types in the first Gulf War. As with 'Sidewinder', the designs have been widely copied and early variants may still be in service with some countries.

Long range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AIM-54A Phoenix	3.96 m	380 mm	443 kg	60 kg continuous rod	impact or IR	semi-active radar, solid update and active radar	solid	in service	Also used by Iran
AIM-54C Phoenix	3.96 m	380 mm	463 kg	60 kg continuous rod	active radar proximity	semi-active radar, inertial and active radar	solid	in service	Improved version of AIM-54A

AIR-TO-SURFACE MISSILES

Argentina

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Mathogo	1.0 m	102 mm	11.3 kg	2.8 kg HE	n/k	wire guided or TV	solid	in service	No known exports
Martin Pescador (MP)	2.94 m	220 mm	140 kg	40 kg HE blast	n/k	radio command	solid	in service	Also known as 'Kingfisher'
MP-1000	2.94 m	220 mm	145 kg	40 kg HE blast	n/k	wire guided	solid	in service	Improved version of the MP

The Argentine Martin Pescador (Kingfisher) missile
0504705

Brazil

Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
FOG-MPM	1.5 m	180 mm	33 kg	HE	n/k	TV fibre optic	solid	Was due in service 2002	Current status not known

China

Short range

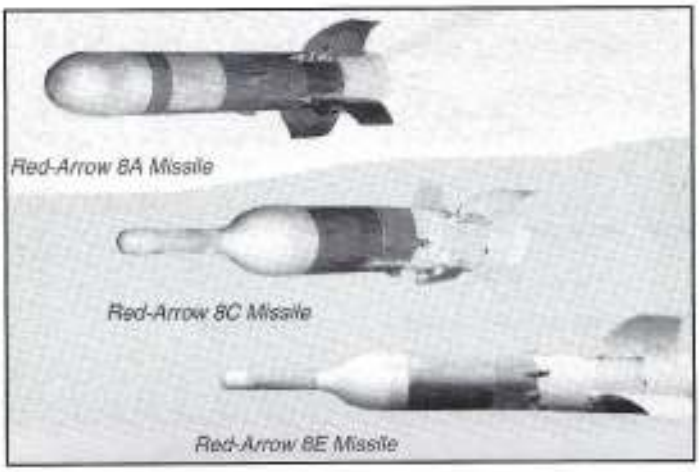
Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Hongjian (Red Arrow) 8A	0.88 m	120 mm	11.2 kg	3 kg HEAT	impact	wire guided	solid	in service	Based on Russian AT-3 'Sagger'
Hongjian (Red Arrow) 8C	1.15 m	120 mm	12.5 kg	4 kg Tandem HEAT	impact	wire guided	solid	in service	
Hongjian (Red Arrow) 8E	1.3 m	120 mm	14 kg	4 kg Tandem HEAT	impact	wire guided	solid	in service	

Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
FL-6	4.8 m	316 mm	340 kg	70 kg HE SAP	impact with short delay	inertial and active radar	solid	in service	Iranian copy of Marte 2
TL-6/C-704	3.5 m approx	280 mm	350 kg approx	120 kg HE SAP	impact or short delay	active radar	solid	in production	Believed to be similar to the Iranian 'Nasr'
TL-10/KJ-10	2.5 m	180 mm	105 kg	30 kg HE SAP	impact or short delay	active radar	solid	in production	Believed to be similar to the Iranian 'Kosar'
YJ-1/C-801	4.65 m	360 mm	655 kg	165 kg HE SAP	n/k	inertial and active radar	solid	in service	Anti-ship missile. Exported to Iran, North Korea, Thailand and Yemen
YJ-7/C-701	2.51 m	180 mm	100 kg	15–30 kg SAP	impact	TV, SAL or IIR	solid	in service	May also be used by Iran
YJ-16/C-101	7.5 m	540 mm	1,850 kg	300 kg HE SAP	n/k	inertial and active radar	ramjet	in service	Anti-ship missile

Long range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
YJ-6/C-601/ CAS-1 'Kraken', YJ-61 and YJ-63	7.1 m (YJ-61: 7.36 m)	760 mm	2,440 kg	513 kg HE SAP	RF	inertial and active radar or TV (YJ-63)	liquid fuelled rocket	in service	Based on HY-1 'Silkworm' and HY-2 'Seersucker'
HY-4/C-201	7.36 m	760 mm	1,740 kg	513 kg HE shaped charge	n/k	autopilot and active radar	Kerosene turbojet	in service	Updated version of YJ-6 'Kraken'
YJ-8/C-801	4.65 m	360 mm	655 kg	165 kg HE SAP	n/k	inertial and active radar	solid	in service	Also used by Iran
YJ-82/C-802	5.3 m	360 mm	555 kg	165 kg HE SAP	n/k	inertial and active radar	turbofan	in service	Also used by Iran
YJ-91/KR-1	4.7 m	360 mm	600 kg	87 kg HE/frag	n/k	inertial and passive radar	solid and ramjet	in production	Based on the' Russian AS-17 'Krypton
HN-1B	6.4 m	520 mm	1,200 kg	400 kg HE	n/k	INS/GPS, tercom, TV	turbojet	in service	Can carry a 90 kT nuclear warhead
HN-2	6.4 m	700 mm	1,400 kg	400 kg HE	n/k	INS/GPS, tercom, TV	turbofan	believed to be in service	Can carry a 90 kT nuclear warhead
HN-3	6.4 m	750 mm	1,800 kg	400 kg HE	n/k	INS/GPS, tercom, TV	turbofan	believed to be in service	Can carry a 90 kT nuclear warhead



Versions of the Chinese Hongjian ('Red Arrow') 8 missile
(NORINCO)
0051949

HY-4 is similar to the YJ-6 'Kraken' (based on the HY-1 'Silkworm') but uses a Kerosene-fuelled turbojet motor 0504318

France

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AS 11	1.21 m	164 mm	30 kg	4.5 kg HE	impact	wire guided	solid	see Note	see Note
AS 12	1.87 m	180 mm	76 kg	30 kg HE	impact	wire guided	solid	see Note	see Note

Note: Optional SAP, frag and shaped charge warheads. Ground-launched versions (SS 11 and 12) are similar. Widely exported.
No longer in service with France, but believed to be in use with other countries.

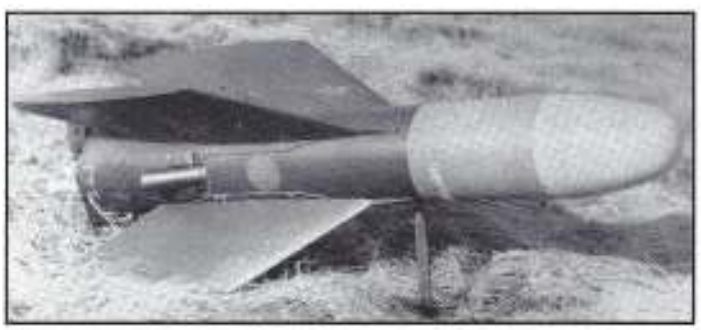
Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AM 39 Exocet	4.7 m	350 mm	670 kg	165 kg HE shaped charge	impact, with active radar proximity back-up	inertial and active radar	solid	in service	Anti-ship missile. Used in the Falklands war. Widely exported
ARMAT	4.15 m	400 mm	550 kg	150 kg HE blast	radar	inertial and passive radar	solid	in service	Anti-radar missile. Exports to the Middle East, including Iraq
AS 15TT	2.3 m	188 mm	100 kg	30 kg HE	impact, short delay	radio command	solid	in service	Anti-ship missile.
AS 30L	3.65 m	342 mm	520 kg	240 kg HE	impact	inertial and semi-active laser	solid	in service	see Note

Note: Used during the first Gulf War, Bosnia and Kosovo. Exports may include Egypt, India, Iraq, Jordan, Nigeria and Pakistan.

Long range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
ASMP	5.38 m	380 mm	860 kg	300 kT nuclear	n/k	inertial and terrain mapping	solid booster and ramjet	in service	No known exports



French SS-11, the ground-launched version of AS-11 0504322

French AM 39 'Exocet' missiles (Jane's/Duncan Lennox) 0007750

Germany

Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AS 34 Kormoran 1	4.4 m	345 mm	600 kg	165 kg HE SAP. See Note	impact with short delay	inertial and active radar	solid	in service	Anti-ship missile. In service with Germany and Italy

Medium range (continued)

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AS 34 Kormoran 2	4.4 m	345 mm	630 kg	220 kg SAP (80 kg HE). See Note	impact with short delay	inertial and active radar	solid	in service	Anti-ship missile

Note: Warheads are reported to incorporate multiple shaped charge liners along the sides.

Long range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Armiger	4.0 m	200 mm	230 kg	20 kg HE frag	proximity/ impact	RF/ Imaging IR	ramjet	in development	Seeker is known as 'ARAS'

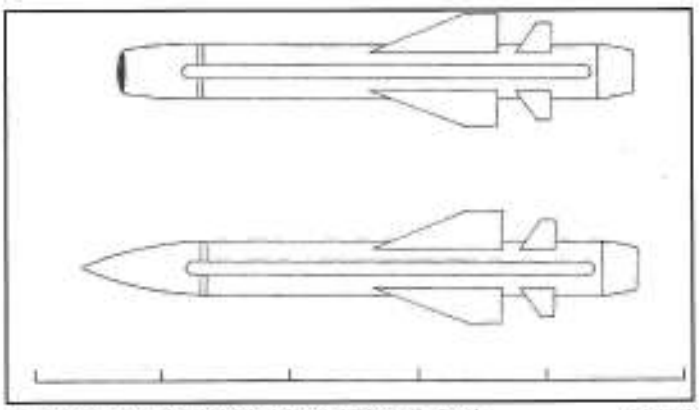
A German AS 34 'Kormoran 2' missile (Jane's/Duncan Lennox)
0054590

International

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
HOT 1	1.27 m	136 mm	23.5 kg	5 kg HE shaped charge	impact	wire guided	solid	in service	Widely exported. Used during the Gulf war
HOT 2	1.3 m	150 mm	23.5 kg	5 kg HE shaped charge	impact	wire guided	solid	in service	Upgraded version of HOT 1
HOT 3	1.3 m	150 mm	32.5 kg	6.5 kg Tandem shaped charge	IR	wire guided	solid	in service	Tandem warhead version of HOT 2
Trigat LR	1.57 m	150 mm	48 kg	HE double hollow charge	impact	imaging IR	solid	under development	

The Apache missile (Peter Humphris) 0007773

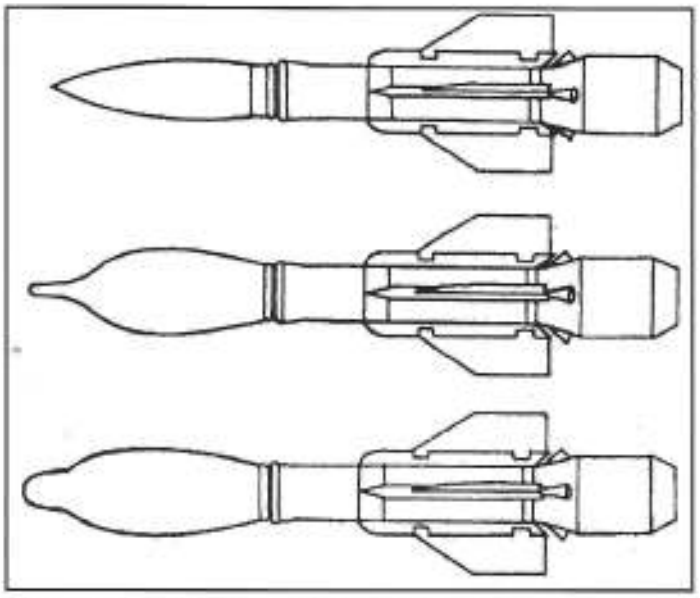


Martel missiles: AJ 168 (above) and AS 37 (below) 0567409

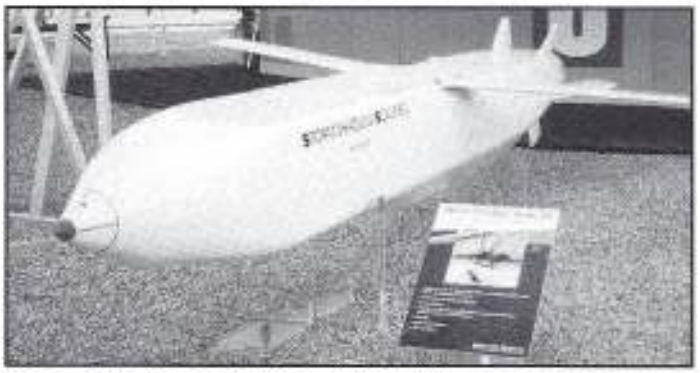
Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AJ 168 Martel TV	3.9 m	400 mm	520 kg	150 kg SAP	Radar	TV	solid	obsolete	Formerly in service with the UK
AS 37 Martel AR (anti-radar)	4.2 m	400 mm	535 kg	150 kg HE blast/ fragmentation	Radar	Passive radar	solid	operational 1970, now obsolescent	May be in service in the Middle East
PGM-1A/ -2A/-3A 'Hakeem'	3.6 m	350 mm	300 kg	227 kg blast/ fragmentation	Active radar MFBF	inertia with SAL, IIR or TV	solid	in service	also known as PGM-500
PGM-1B/ -2B/-3B 'Hakeem'	4.6 m	430 mm	1,115 kg	910 kg blast/ fragmentation	Active radar MFBF	inertia with SAL, IIR or TV	solid	in service	also known as PGM-2000

The tandem MEPHISTO penetration warhead inside the KEPD 350
(Duncan Lennox) 0024915



Diagrams of the 'HOT' range of missiles. The tandem warhead version was initially designated 'HOT 2T', then renamed 'HOT 3' 0504878



The Scalp EG/Storm Shadow missile
(Peter Humphris) 0054585

Long range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Apache	5.1 m	630 mm wide, 480 mm high	1,230 kg	10 × KRISS submunitions	n/k	inertial and imaging radar	turbojet	in service	Cruise missile
KEPD	5.1 m	630 mm wide, 320 mm high	1,400 kg 'MEPHISTO'	495 kg tandem first stage; penetration warhead	Electro-optical intelligent second stage	INS/GPS, ternav, IIR	turbojet	entering service	Cruise missile
Scalp EG/Storm Shadow	5.1 m	630 mm wide, 480 mm high	1,300 kg warhead	Tandem 'Broach' 'MAFIS' laser	impact and IR proximity	GPS and imaging	turbojet	in service	Cruise missile. Used in Iraq

Iran

Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Kosar	2.5 m	180 mm	105 kg	30 kg HE SAP	impact or short delay	active radar	solid	in production	Believed to be the same as the Chinese TL-10/KJ-10
Nasr	3.5 m approx	280 mm	350 kg approx	120 kg HE SAP	impact or short delay	active radar	solid	in production	Believed to be similar to the Chinese TL-6/C-704
PGM	3.5 m	400 mm	550 kg	240 kg HE	n/k	TV	solid	in service	
Sattar-1	2.5 m	300 mm	210 kg	55 kg HE	n/k	semi-active laser	solid	in service	A variant known as Sattar-2 is also in service
'Sea Dawn' (Fajr-e Darya)	4.8 m	316 mm	340 kg	70 kg HE SAP	impact with short delay	inertial and active radar	solid	in service	Copy of Italian Marte 2
Zoobin (AGM-379/20)	3.18 m	406 mm	560 kg	750 lb M117 bomb (340 kg HE)	impact	TV	solid	in service	Used during the Iran-Iraq war

Long range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Noor	5.3 m	360 mm	555 kg	165 kg HE SAP	n/k	inertial with active radar	turbofan	in production	A copy of the Chinese C-802

The Zoobin missile uses a 750lb M117 bomb as the warhead (Robert Hewson)
0533815

Israel

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Spike-LR (NT-S)	1.2 m	135 mm	11 kg	3 kg tandem HEAT	n/k	TV/IR	solid	in service	Similar to US 'TOW-2B'
Spike-ER (NT-D) 'Dandy'	1.9 m	135 mm	27 kg	6.5 kg tandem HEAT	n/k	TV/IR	solid	in service	Lengthened version of 'Spike'

Medium range

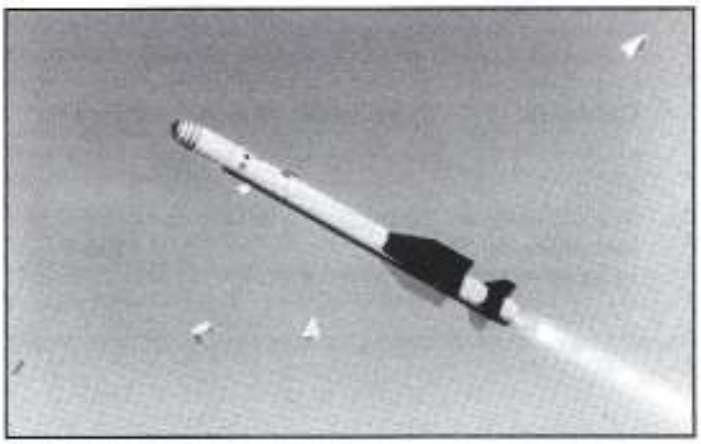
Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AGM-142 Popeye 1	4.82 m	533 mm	1,360 kg	*Note 1*	*Note 2*	inertial, update and TV or imaging IR	solid	in service	Used during the Gulf War and in Kosovo. *Note 3*
Delilah (STAR-1)	2.71 m	330 mm	182 kg	30 kg blast	n/k	GPS/INS. Possible terminal seeker option	turbojet	in service	Lightweight cruise missile
Gabriel 3AS	3.85 m	340 mm	560 kg	150 kg HE SAP	impact	inertial, update and active radar	solid	in service	Anti-ship missile. Some exports
Popeye 2 'Have Lite'	4 m	533 mm	1,115 kg	*Note 1*	*Note 2*	inertial, update and TV or imaging IR	solid	in service	Smaller version of Popeye 1. Also produced by Turkey. *Note 3*
Nimrod	2.84 m	210 mm	100 kg	15 kg HEAT	n/k	inertial and semi-active laser	solid	in service	

Note 1: Two warhead options: 350 kg fragmentation (150 kg HE) or 352 kg penetration (77 kg HE).
Note 2: 350 kg fragmentation warhead uses 2 x FMU-124 fuzes. The 352 kg penetration warhead uses 2 x FMU-143 fuzes.
Note 3: Produced in conjunction with the US; missiles are also in service with the USAF.

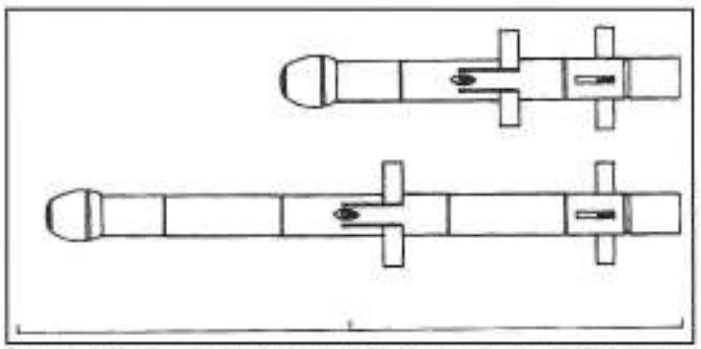
'Delilah' (STAR-1) lightweight cruise missile
(Duncan Lennox)
0504867

Long range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Gabriel 4LR	4.7 m	440 mm	960 kg	240 kg HE SAP	impact	inertial, update and active radar	solid and turbojet	in service	Ship-launched version widely exported
STAR-1 'Delilah'	2.71 m	330 mm	182 kg	30 kg HE	n/k	GPS/INS	turbojet	in service	



The Nimrod anti-armour missile (IAI) 0552844



Diagrams of Israeli NT-S 'Spike' (above) and NT-D 'Dandy' (below)
0092775

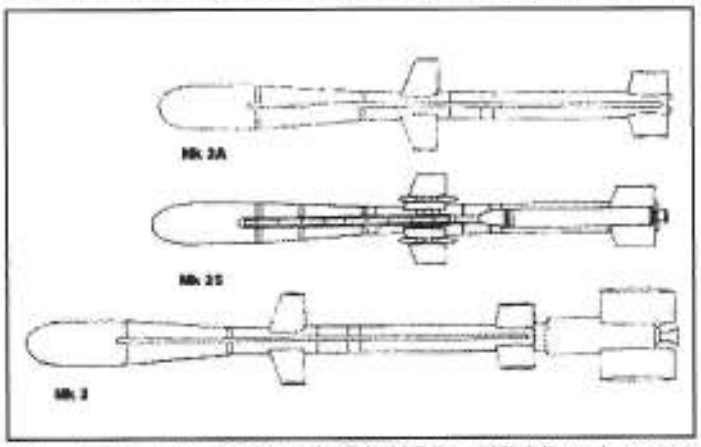
The AGM-142 'Popeye 1' was used in the Gulf and Kosovo
(Rafael)
0504866

Italy

Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Marte 2	4.8 m	316 mm	340 kg	70 kg HE SAP	impact with short delay	inertial and active radar	solid	in service	Anti-ship missile. No known exports
Marte 2A	3.9 m	316 mm	269 kg	70 kg HE SAP	impact with short delay	passive radar	solid	in service	Anti-ship missile. No known exports
Marte 2S	3.8 m	316 mm	324 kg	75 kg HE SAP	impact and proximity	inertial and active radar	solid	in service	Helicopter-launched anti-ship missile

Note: Marte 2 is reported to be copied by Iran as Fajr-e Darya 'Sea Dawn', used by China under the name 'FL-6'



Italian Marte missiles: 2A (upper), 2S (middle) and Mk 2 (lower) 0024919

The Italian Marte 2A (Duncan Lennox) 0007767

Japan

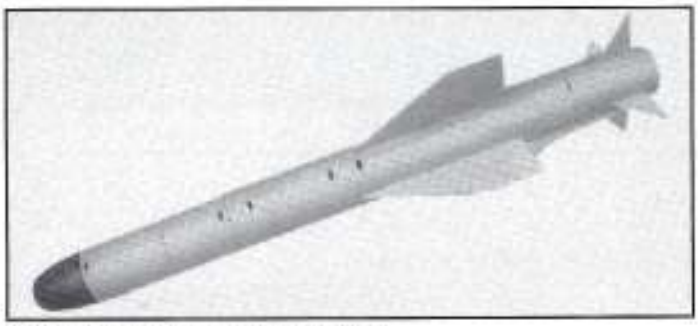
Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
ASM-1 (Type 80)	4 m	335 mm	600 kg	150 kg HE SAP	impact	inertial and active radar	solid	in service	Anti-ship missile. No known exports
ASM-1C (Type 91)	4 m	350 mm	510 kg	150 kg HE SAP	impact	inertial and active radar	solid	in service	Anti-ship missile. Improved version of ASM-1

Long range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
ASM-2 (Type 93)	4.1 m	350 mm	520 kg	150 kg HE (est) SAP	Probably impact fuzed	inertial, updates with imaging IR or passive radar	turbojet	in service	Similar to ASM-1

The Japanese ASM-1 (Type 80) air-to-surface missile (Mitsubishi Heavy Industries) 0024922



ASM-1C is a lightened version of ASM-1 (Mitsubishi Heavy Industries) 0024921

Norway

Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AGM-119A Penguin 3	3.18 m	280 mm	370 kg	130 kg HE SAP	impact	inertial and passive IR	solid	in service	Anti-ship missile
AGM-119B Penguin 2 Mod 7	2.96 m	280 mm	385 kg	120 kg HE SAP	impact	inertial and passive IR	solid	in service	Anti-ship missile. Exported within Europe, and to Australia

Note: Developed from ship-to-ship missiles. The original Penguin 1 is now obsolete.

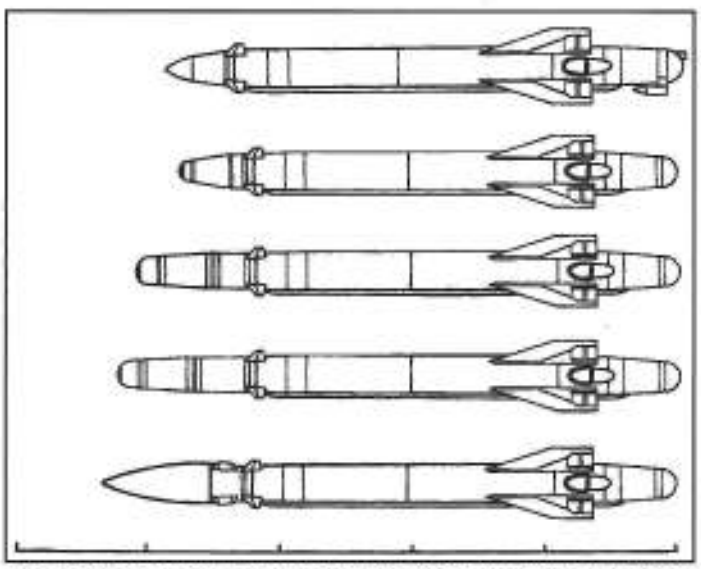
Penguin Mk3 air-to-surface missile (AGM-119A)
0504345

Russian Federation

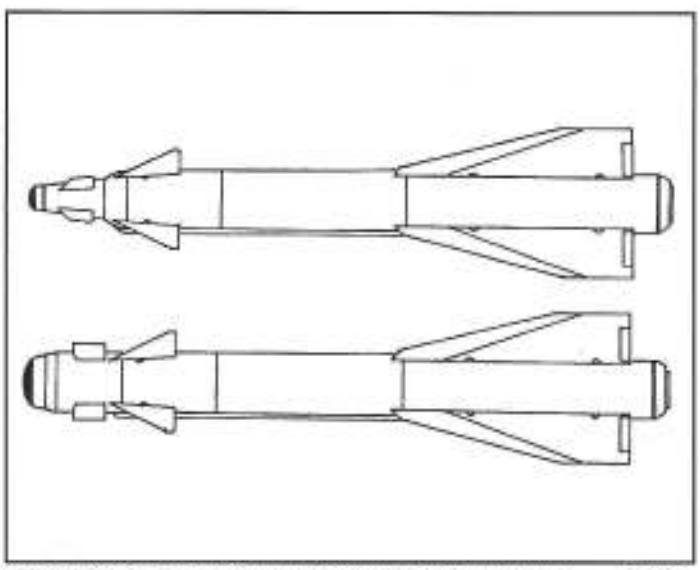
Note: Many of these missiles were exported and even obsolete types may be in use in some countries or have been upgraded.

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuzing	Guidance	Propulsion	Status	Remarks
AS-7 'Kerry'	3.6 m	275 mm	288 kg	108 kg HE shaped charge	impact	radio command	solid	in service	Widely exported
AS-10 'Karen'	3.69 m	275 mm	300 kg approx	Various: 86–140 kg HE	RF	semi-active laser or radio command	solid	in service	Various configurations. Widely exported
AT-2A/B/C 'Swatter'	1.16 m	132 mm	30 kg	HEAT	impact	radio command	solid	in service	Widely exported



Russian AS-10 configurations: (from the top) Kh-25MR, Kh-25ML, Kh-25MT, Kh-25MTP and Kh-25MA
0092784



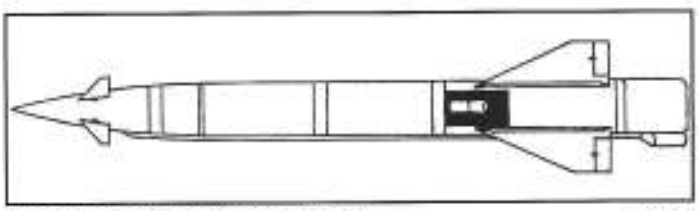
AS-14 'Kedge' variants: Kh-29L (above) and Kh-29T (below)
0504361

Short range (continued)

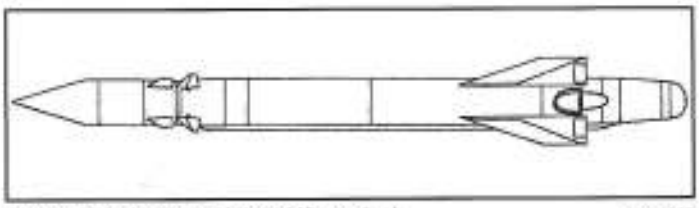
Missile designator and name	Length	Diameter	Weight	Warhead	Fuzing	Guidance	Propulsion	Status	Remarks
AT-3 'Sagger', Malyutka-2, Malyutka-2F	0.86–0.98 m	125 mm	11.3–12.5 kg	2.5–3.5 kg HEAT	impact	wire guided	solid	in service	Various configurations. Widely exported
AT-6 'Spiral'	1.83 m	130 mm	33.5 kg	5.4 kg HEAT	impact	radio command	solid	in service	
AT-9 'Spiral 2'	1.83 m	130 mm	40 kg	7.4 kg HEAT	impact	radio command	solid	in service	
AT-12 'Swinger'	1.7 m	130 mm	42.5 kg	8 kg (see Remarks)	impact and proximity	radio command	solid	in service	Optional warheads: tandem HEAT, continuous rod and HE frag
AT-16 (Vikhr-M)	2.8 m	130 mm	72 kg	8 kg HEAT	impact and proximity	semi-active laser	solid	in service	Improved variant of AT-12
S-25LD	4.1 m	340 mm	400 kg	155 kg HE	n/k	semi-active laser	solid	in service	

Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuzing	Guidance	Propulsion	Status	Remarks
AS-9 'Kyle'	6.04 m	430 mm	715 kg	155 kg HE	n/k	passive radar	liquid	obsolete	Anti-radar missile
AS-10 'Karen' (Kh-25 series)	4–4.3 m	275 mm	300–320 kg	86 kg HE	RF	TV, IR or passive radar	solid	in service	Various roles and configurations, including short range versions
AS-11 'Kilter' (Kh-58E)	4.8 m	380 mm	650 kg	149 kg HE or nuclear	active radar	inertial and passive radar	solid	in service	
AS-12 'Kegler'	4.19 m	275 mm	320 kg	86 kg blast/fragmentation	n/k	inertial and passive radar	solid	in service	Anti-radar missile. Widely exported
AS-13 'Kingbolt' (Kh-59 OVOD)	5.1 m	380 mm	790 kg	148 kg HE	n/k	TV command	solid	in service	Offered for export
AS-14 'Kedge' (Kh-29 series)	3.87 m	380 mm	657–700 kg	317 kg HE	n/k	semi-active laser or TV command	solid	in service	Various configurations. In use by several former WP countries and offered for export
AS-17 'Krypton' (Kh-31)	4.7 or 5.23 m	360 mm	600 kg	90 kg HE blast/fragmentation or HE penetration	n/k	inertial with active or passive radar	solid and ramjet	in service	Several variants. Exports include China and India



Russian AS-7 'Kerry' (Kh-23M version) 0504991

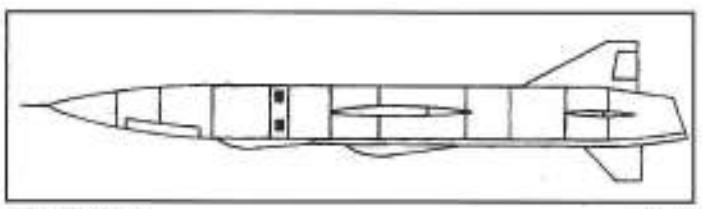


Russian AS-12 'Kegler' (Kh-25MP version) 0504993

Long range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuzing	Guidance	Propulsion	Status	Remarks
3M51 'Alfa'	6.0 m	550 mm	1,500 kg	300 kg HE	n/k	inertial with active/ passive radar	turbojet	entering service	
3M55 'Yakhont'	8.3 m	670 mm	2,550 kg	200 kg HE	n/k	inertial with active radar	ramjet	entering service	Also to be used by India
AS-4 'Kitchen'	11.67 m	920 mm	5,780–6,000 kg	930 kg HE or 200 kT nuclear	radar	inertial and passive radar or active radar	liquid	obsolete	Can have blast or SAP warhead
AS-6 'Kingfish'	10.9 m	920 mm	5,950 kg	1,000 kg HE or 350 kT nuclear	n/k	inertial and passive radar or active radar	solid	obsolete	
AS-11 'Kilter'	4.8 m	380 mm	640–650 kg	149–152 kg blast/ fragmentation or nuclear	active radar	inertial and passive radar	solid	in service	Anti-radar missile
AS-15A /B/ C 'Kent'	6.04 m	514–770 mm	1,210–1,700 kg	410 kg HE submunitions or 200–250 kT nuclear	n/k	inertial with terrain comparison	turbofan	in service	Various configurations
AS-16 'Kickback'	4.78 m	455 mm	1,200 kg	150 kg HE or 350 kT nuclear	n/k	inertial with active or passive radar	solid	in service	Also used by Ukraine
AS-18 'Kazoo'	5.37 m	380 mm	930 kg	320 kg HE or submunitions	n/k	inertial with TV command	turbojet	in service	Can have nuclear warhead
AS-20 'Kayak'	3.75 m	420 mm	480 kg	145 kg HE SAP	impact	inertial with active radar	turbofan	in service	Impact fuzed
Kh-41 Moskit	9.74 m	760 mm	4,500 kg	320 kg blast/ fragmentation	impact	inertial with active/ passive radar	solid and ramjet	under development	
Kh-59ME	5.7 m	380 mm	930 kg	320 kg AP HE or 280 kg cluster	n/k	inertial and TV/electro-optic	turbojet	in service	Exported to China and Venezuela
Kh-59MK	5.7 m	380 mm	930 kg	320 kg AP HE	n/k	inertial and radar	turbojet	in service	Exported to China
Kh-65SE	6.04 m	514 mm	1,300 kg	410 kg penetration	n/k	inertial with active radar	turbofan	under development	
Kh-101	7.45 m	n/k	2,400 kg	400 kg HE	n/k	inertial with EO	turbojet	entering service	

Russian AS-14 'Kedge' (Kh-29T) TV-guided missile, with an AA-11 'Archer' behind
(Peter Humphris)
0504995



AS-4 'Kitchen' 0054588

South Africa

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuzing	Guidance	Propulsion	Status	Remarks
ZT3 'Swift'	1.35 m	127 mm	19 kg	HEAT	impact	laser CLOS	solid	in service	Used in Angola
'Mokopa' (ZT6)	1.8 m	178 mm	52 kg	Tandem HEAT	impact	semi-active laser or active radar	solid	believed to be in service	Formerly known as ZT6
'Ingwe' (ZT35)	1.75 m	127 mm	28.5 kg	Tandem HEAT	impact	laser beam rider	solid	in service	Formerly known as ZT35. Offered for export

Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuzing	Guidance	Propulsion	Status	Remarks
BARB	3.5 m	273 mm	450 kg	240 kg HE (Mk 82)	n/k	passive radar	solid	under development	Anti-radar missile

Long range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuzing	Guidance	Propulsion	Status	Remarks
MUPSOW	4.920 m	641 mm	1,200 kg	Submunition, unitary or blast/frag warhead options	impact	inertial and imaging IR or TV	turbojet	under development	Exact status is uncertain
Raptor 2	3.65 m	380 mm	1,200 kg	Mk 84 bomb body (428 kg HE)	impact	inertial with TV/IIR	solid	in service	Based on Raptor 1 glide bomb PGM

South African 'Ingwe' anti-tank missile (Denel/Kentron) 0130539

Mokopa ZT-6 anti-armour missile (Denel/Kentron) 0081401

Sweden

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuzing	Guidance	Propulsion	Status	Remarks
RB05	3.6 m	300 mm	305 kg	n/k	n/k	radio command	liquid	believed to be obsolete	Note: liquid propellant

Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuzing	Guidance	Propulsion	Status	Remarks
RB04	4.45 m	500 mm	600 kg	150 kg SAP	n/k	inertial and active radar	solid	uncertain	Anti-ship missile. No known exports
Rbs 15F Mk 1	4.35 m	500 mm	598 kg	200 kg SAP	impact with short delay, and proximity	inertial and active radar	turbofan	in service	Anti-ship missile. Exported to Croatia and Finland
Rbs 15F Mk 2	4.33 m	500 mm	630 kg	200 kg SAP	impact with short delay, and proximity	inertial and active radar	turbofan	in service	Anti-ship missile. Improved version of RBS 15F

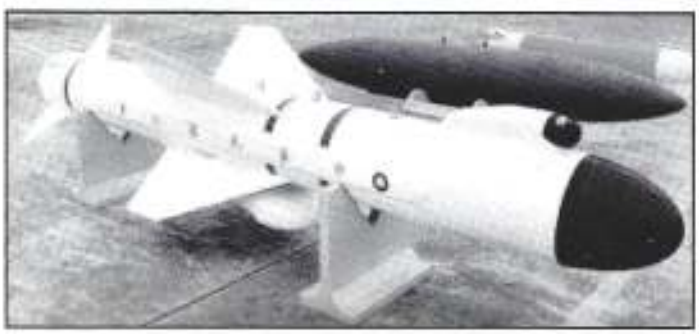
A Swedish RBS 15F air-to-surface missile (Peter Humphris) 0092786

Taiwan

Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Hsiung Feng 2	3.9 m	340 mm	520 kg	225 kg SAP or self-forging fragment	impact with short delay	inertial and active radar with imaging IR	turbofan	in service	Anti-ship missile. No known exports
Tien Chieng IIA	3.6 m	190 mm	183 kg	22 kg HE/ frag	n/k	passive RF	solid	believed to be in service	Anti-radiation missile based on Sky Sword II

Note: Replaced Hsiung Feng 1, which was developed from the Israeli Gabriel 2. A larger missile, designated Hsiung Feng 3, is believed to be in development.



The air-launched version of Hsiung Feng 2 (CSIST) 0130640

United Kingdom

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
Brimstone	1.63 m	178 mm	50 kg	Tandem HEAT	n/k	active radar	solid	entering service	300 g precursor charge; 6.2 kg main charge
Typhoon	2.9 m	166 mm	77 kg	HE	n/k	imaging IR	solid	under development	

Medium range

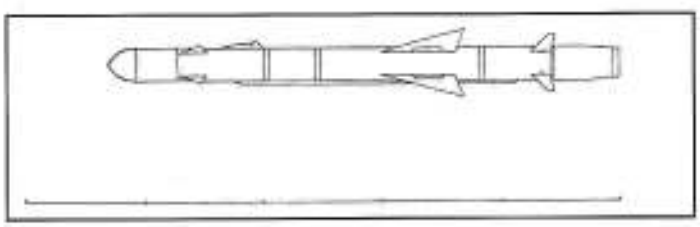
Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
ALARM	4.3 m	224 mm	268 kg	HE fragmentation	active laser proximity	inertial and passive radar	solid	in service	Anti-radar missile. Used in the Gulf War, Serbia and Kosovo
Sea Skua	2.5 m	250 mm	147 kg	30 kg SAP	impact	semi-active radar	solid	in service	Anti-ship missile. Used in the Falklands and Gulf War. Some exports
Sea Skua Mk 2	2.5 m	250 mm	150 kg	n/k	impact	inertial with active radar	solid	under development	Due in service 2011

Rear view of British PGM-2000 (left) and PGM-500 (right) missile; note the venturi for the solid-fuel motors (Jane's/Duncan Lennox) 0054584

British 'Sea Skua' missile; note the angled nozzle of the sustainer motor in front of the rear fins (Jane's/Duncan Lennox) 0016750

Long range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
PGM-4 (Centaur)	5.0 m	430 mm	1,150 kg	n/k	n/k	inertial with imaging IR	turbojet	under development	
Sea Eagle	4.14 m	400 mm	600 kg	230 kg SAP	impact with short delay	inertial and active radar	turbofan	in service	Some exports
Storm Shadow	5.1 m	630 mm	1,300 kg	400 kg HE	n/k	inertial with GPS, Terprom and imaging IR	turbofan	under development	



The ALARM anti-radar missile
0567408

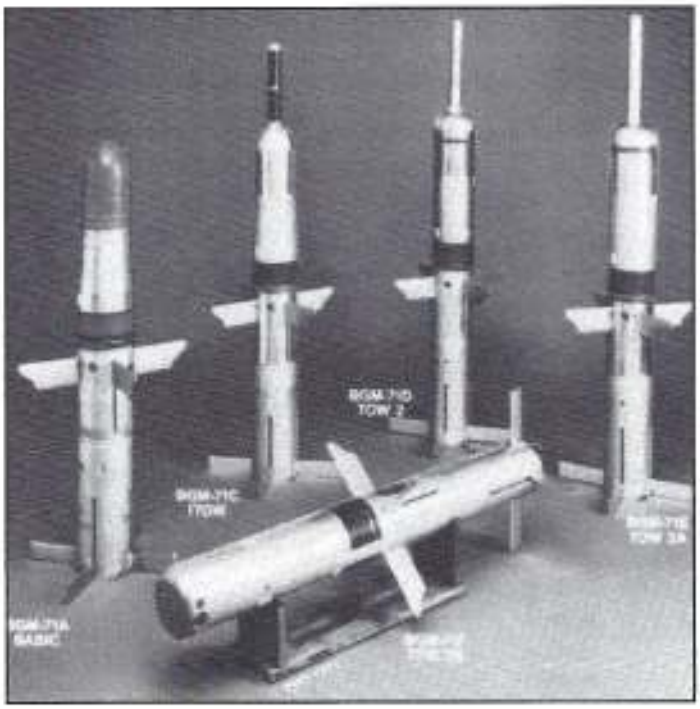
United States

Short range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AGM-12 Bullpup A	3.2 m	305 mm	258 kg	113 kg HE	n/k	radio command	liquid	obsolete	Based on 250 lb GP bomb
AGM-12 Bullpup B	4.14 m	450 mm	812 kg	454 kg HE	n/k	radio command	liquid	obsolete	Based on 1,000 lb GP bomb
AGM-65A Maverick	2.49 m	305 mm	210 kg	57 kg HE shaped charge	impact	TV	solid	in service	see *Note 1*
AGM-65B Maverick	2.49 m	305 mm	210 kg	57 kg HE shaped charge	impact	TV	solid	in service	see *Note 1*
AGM-65H Maverick	2.49 m	305 mm	307 kg	136 kg HE blast	impact	TV	solid	in service	see *Note 1*
AGM-114A/B/C/K Hellfire ½	1.63 m	178 mm	45.7 kg	8 kg HE shaped charge	impact	semi-active laser	solid	in service	see *Note 1*
AGM-114F Hellfire	1.8 m	178 mm	48.6 kg	Tandem HEAT	impact	semi-active laser	solid	in service	see *Note 1*
AGM-114K (Hellfire 2)	1.63 m	178 mm	45.7 kg	Tandem HEAT	impact	semi-active laser	solid	in service	see *Note 1*
AGM-114 L (Longbow Hellfire 2)	1.78 m	178 mm	50 kg	Tandem HEAT	impact	inertial and MMW radar	solid	in service	see *Note 1*
AGM-114M (Hellfire 2)	1.63 m	178 mm	47.9 kg	HE/frag	impact	semi-active laser	solid	in service	see *Note 1*
AGM-114N	1.78 m	178 mm	n/k	Thermobaric	n/k	semi-active laser	solid	in service	
AGM-122 Sidearm	3.0 m	127 mm	91 kg	10.2 kg HE blast/ fragmentation	impact and active laser proximity	passive radar	solid	in service	Anti-radar. No known exports
AGM-123 Skipper	4.33 m	356 mm	582 kg	454 kg Mk 83 bomb	impact with short delay	semi-active laser	solid	in service	Based on Mk 83 bomb
BGM-71A/ B TOW	1.17 m	150 mm	19 kg	HEAT	impact	wire guided	solid	in service	see *Note 2*
BGM-71C ITOW	1.45 m	150 mm	19 kg	4 kg HE	impact	wire guided	solid	in service	see *Note 2*
BGM-71D/ETOW 2/2A	1.55 m	150 mm	21.5 kg	6 kg Tandem HEAT	impact	wire guided	solid	in service	see *Note 2*
BGM-71F TOW 2B	1.17 m	150 mm	22.6 kg	6 kg Tandem HEAT	impact	wire guided	solid	in service	Downward-facing HEAT charges
GBU-44/B 'Viper Strike'	0.914 m	140 mm	19 kg	HEAT/frag, possibly others	impact	semi-active laser	none	in service	Based on BAT submunition

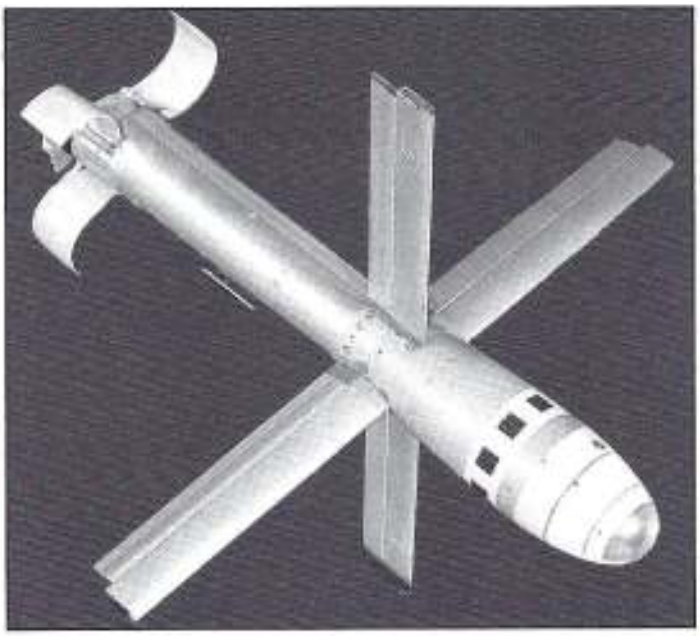
Note 1: Maverick and Hellfire have been widely exported. Both were used in the first Gulf War and recently in Iraq.
Note 2: Used by the US in Vietnam and the Gulf, and in the Middle East by Israel and Iran. Widely exported.

For details of the latest updates to *Jane's Explosive Ordnance Disposal* online and to discover the additional information available exclusively to online subscribers please visit **jeod.janes.com**



US 'TOW' missiles: (left to right) BGM-71A, -71C, -71D and -71E, with -71F in front
0504901

US AGM-114K 'Hellfire 2' missile with tandem HEAT warhead
(US Army) 0054596



GBU-44/B 'Viper Strike' is based on the BAT submunition
(Northrop Grumman)
1127318

Medium range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AGM-45 Shrike	3.05 m	203 mm	177 kg	66 kg HE fragmentation	n/k	passive radar	solid	obsolete	Anti-radar missile. Used in Vietnam and the Middle East
AGM-65D Maverick	2.49 m	305 mm	220 kg	57 kg HE shaped charge	impact	imaging IR	solid	in service	see *Note 3*
AGM-65E Maverick	2.49 m	305 mm	293 kg	136 kg HE blast	impact	semi-active laser	solid	in service	see *Note 3*
AGM-65F Maverick	2.49 m	305 mm	307 kg	136 kg HE blast	impact	imaging IR	solid	in service	see *Note 3*
AGM-65G Maverick	2.49 m	305 mm	307 kg	136 kg HE blast	impact	imaging IR	solid	in service	see *Note 3*
AGM-65H Maverick	2.60 m	305 mm	305 kg	136 kg HE blast	impact	active radar	solid	in service	see *Note 3*

Medium range (continued)

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AGM-78 Standard	4.57 m	340 mm	615 kg	98 kg HE	n/k	passive radar	solid	obsolete	Anti-radar missile. Used by Israel
AGM-88 HARM	4.17 m	254 mm	361 kg	66 kg HE blast/ fragmentation	active laser proximity	passive radar	solid	in service	Anti-radar missile. Used in the Gulf, Serbia and Kosovo
AGM-130A	3.94 m	460 mm	1,323 kg	890 kg HE	impact	TV or imaging IR	solid	in service	Based on Mk 84 bomb
AGM-130C	3.95 m	460 mm	1,353 kg	870 kg HE	impact with short delay	TV or imaging IR	solid	in service	Based on BLU-109 bomb

Note 3: Maverick was used during the first Gulf War (mainly AGM-65D) and in Kosovo. Widely exported. AGM-65J and K are variants of the AGM-65F and G, with 136 kg warheads.

US 'Maverick' missiles: (front to rear) AGM-65D, -65E, -65B and -65F
0504407

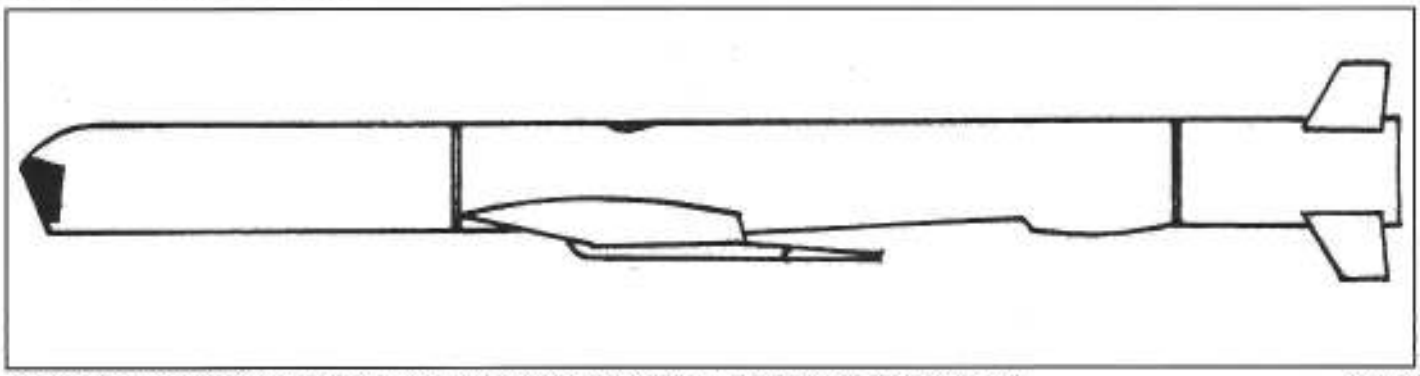
Long range

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AGM-84A Harpoon	3.85 m	343 mm	556 kg	222 kg HE blast	impact	inertial and active radar	turbofan	in service	Harpoon has been widely exported. See *Note 4*

US AGM-88 'HARM' missile (Jane's/Duncan Lennox) 0092770

US AGM-45A 'Shrike' anti-radar missile
(Mike Jenvey)
0504405

Long range (continued)



AGM-84 'Harpoon' missiles: AGM-84A (upper), AGM-84E 'SLAM' (middle) and AGM-84H 'SLAM-ER' (lower) 0504902

Missile designator and name	Length	Diameter	Weight	Warhead	Fuze	Guidance	Propulsion	Status	Remarks
AGM-84E SLAM	4.5 m	343 mm	628 kg	222 kg HE blast	impact	inertial, GPS and imaging IR	turbofan	in service	see *Note 4*
AGM-84H SLAM-ER	4.37 m	343 mm	727 kg	318 kg HE blast	impact	inertial, GPS and imaging IR	turbofan	in service	see *Note 4*. In service with South Korea
AGM-86B ALCM	6.32 m	693 mm	1,458 kg	200 kT nuclear	n/k	inertial with Tercom	turbofan	in service	Some converted to HE warheads
AGM-86C/ D CALCM	6.32 m	693 mm	1,750–1,950 kg	545, 910 or 1,360 kg HE	n/k	inertial with GPS	turbofan	in service	Used in the Gulf, Serbia and Kosovo
AGM-129 ACM	6.35 m	704 mm	1,250 kg	150–170 kT nuclear	n/k	inertial with laser radar	turbofan	in service	
AGM-158A 'JASSM'	4.26 m	550 mm	1,023 kg	432 kg HE AP frag	n/k	inertial/GPS and imaging IR	turbojet	under development	
Grand SLAM	5.31 m	343 mm	1,100 kg	354 kg penetration	n/k	inertial and imaging IR	turbofan	under development	

Note 4: Used during the first Gulf War and recently against Iraq.

AIR-LAUNCHED ROCKETS

Argentina

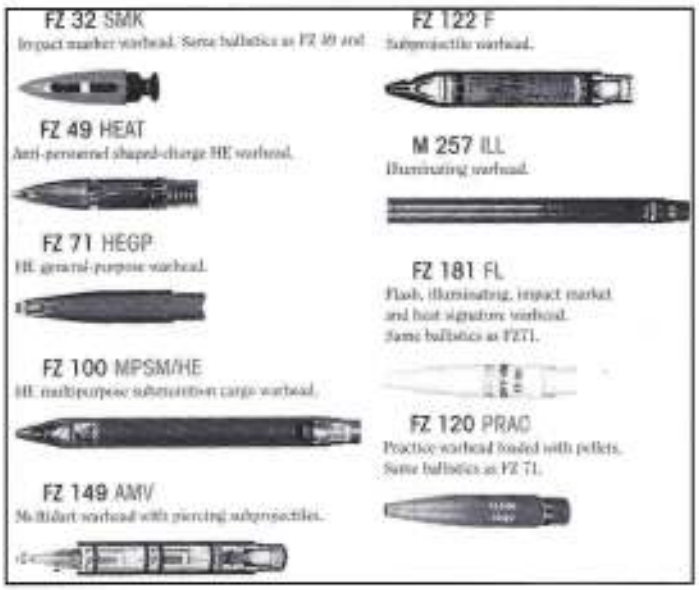
Designation	Calibre	Length	Weight	Warhead	Status	Remarks
ASPID 1057	57 mm	0.6 m	5 kg	HE, AP frag, HEAT, smoke or inert	in service	Designed for use with the Mamboretta-657 6-tube launcher
CBAS-1 'Albatros'	70 mm	1.28 m	10.15–10.5 kg	HEAT/frag, AP frag, APAM, training (smoke)	in service	Weights are with HE warheads (approx 4.5 kg). Widely exported

Argentine 70 mm CBAS-1 rocket with inert warhead 0504751

Belgium

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
FZ 70 (2.75 in) See *Note 1*	70 mm	1.3–1.8 m (depending on warhead)	8–12.6 kg (depending on warhead)	11 various (see *Note 2* and image)	in service	Various FZ motor and warhead combinations. 7, 12 and 19-tube launchers
Zuni Mk 71 Mod 0	130 mm (5 in)	Approx 2.2–2.7 m	Approx 53–60 kg	9 options, see *Note 3*	in service	Fired from 4-tube LAU-10 launcher
Zuni Mk 71 Mod 1	130 mm (5 in)	Approx 2.3–2.8 m	Approx 58–66 kg	9 options, see *Note 3*	in service	Fired from 4-tube LAU-10 launcher
Zuni Mk 16	130 mm (5 in)	Approx 2.4–2.9 m	Approx 49–56 kg	9 options, see *Note 3*	in service	Fired from 4-tube LAU-10 launcher

Note 1: The FZ-70 family of rockets may use FZ 67/68 or FZ 90 motors, and are sometimes referred to by these names.
Note 2: Warhead options include GP, HEAT/frag, blast/frag, multi-dart, flechette, dual-purpose submunition, flash, illuminating, smoke, incendiary and 3 practice types.
Note 3: Warhead options include GP, HEAT/frag, blast/frag, flare, smoke, incendiary and 3 practice types.

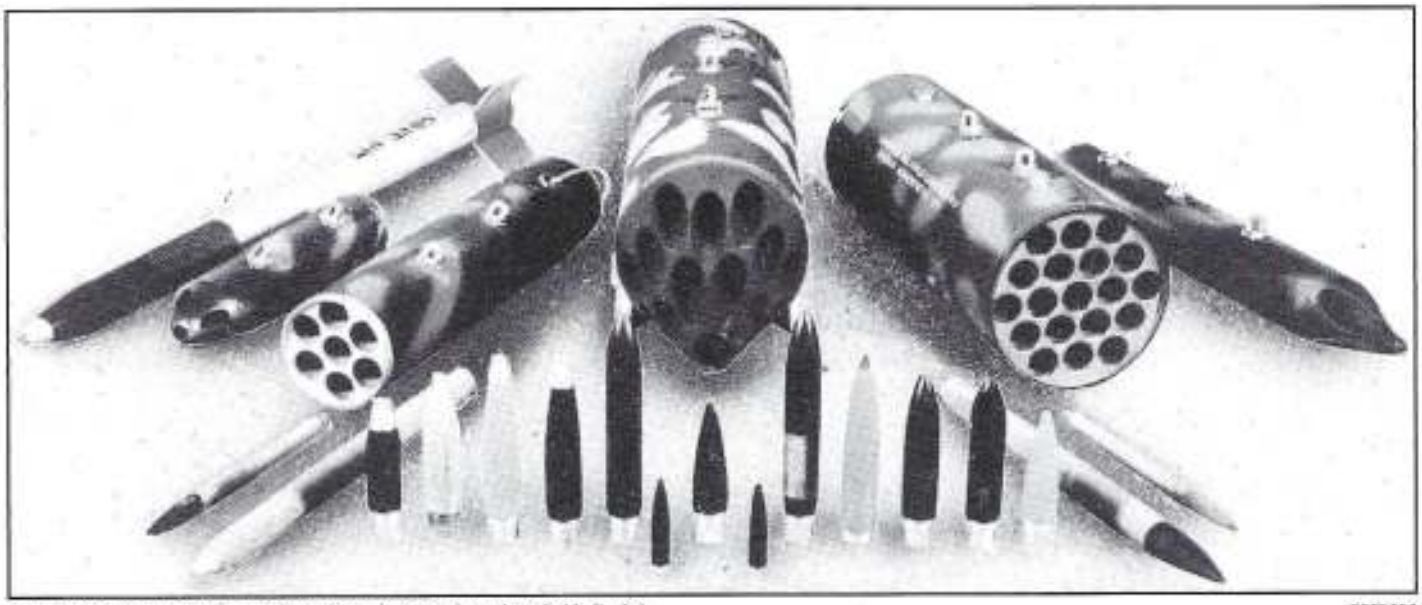


Belgian FZ warhead options for 70 mm air-launched rockets
0007837

Brazil

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
SBAT-37	37 mm	0.63 m	1.21 kg	HEAT, AP frag, HEAT/frag, APAM, WP smoke, practice smoke, practice inert	in service	Fired from LM-37/7 7-tube launcher
SBAT-70	70 mm	1.22 m	6 kg	as above	in service	DB or composite motors. 4-, 7- or 19-tube launcher
SBAT-127	127 mm	1.3 m	48 kg	20 kg HE	in service	
Skyfire	70 mm	1.49–1.78 m	11–15 kg	HE frag, HEAT frag, flechette, WP, practice inert and practice with smoke or flash	in service	see Note

Note: Three rocket motors (M8, M9 and M10) are available for Skyfire. The specifications are for rockets fitted with HE frag warheads.



SBAT 37, 70 and 127 mm rockets, launchers and warheads (Avibrás) 0085151

The nine warhead options for Skyfire; the submunition warhead is on the left (Avibrás) 0085154

Brazilian Skyfire 70 mm rockets.
From the left, SS 09TS, M10, M9, M8, M6B
(Peter Humphris)
0085155

Bulgaria

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
S-5K	57 mm	0.83 m	3.64 kg	1.59 kg HEAT	in service	See Note
S-5KO	57 mm	1.01 m	4.5 kg	HEAT/frag	in service	See Note
S-5M	57 mm	0.88 m	3.86 kg	1.39 kg blast	in service	See Note
S-5MO	57 mm	1.0 m	4.82 kg	2.3 kg blast/frag	in service	See Note

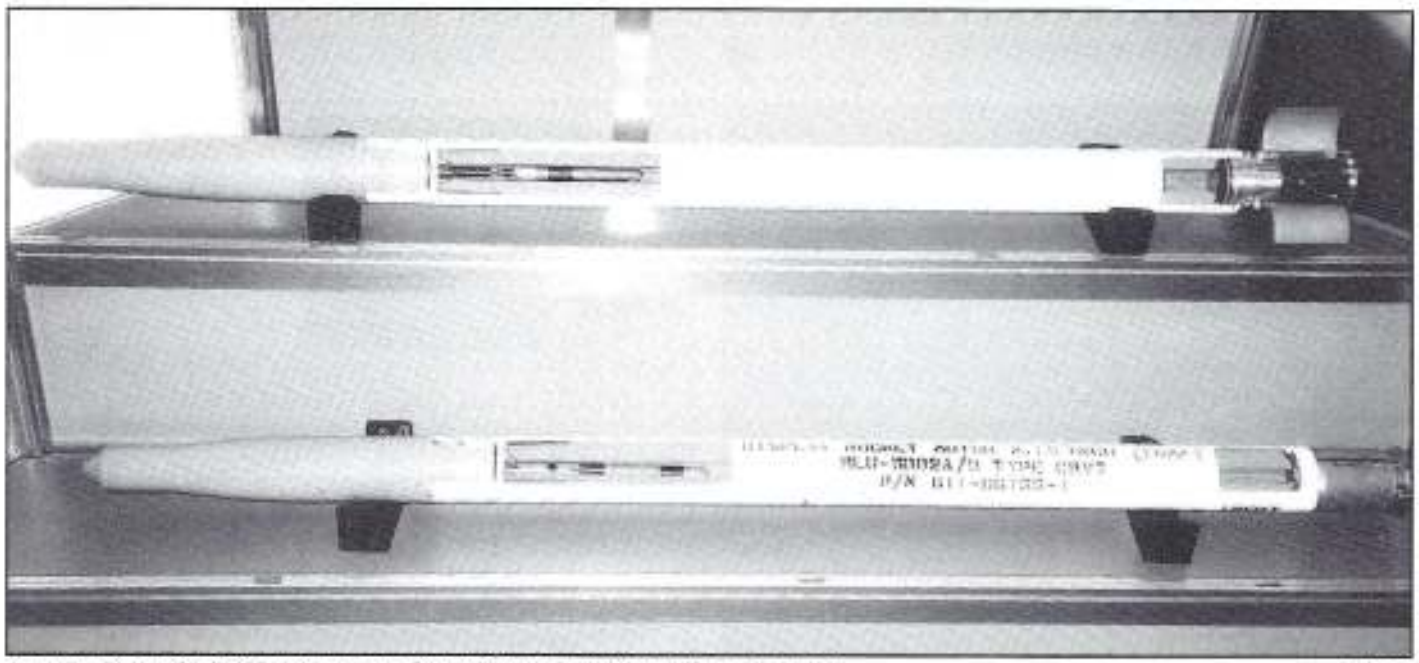
Note: All types are based on the Russian S-5 series (see separate entry) and can be fired from various 57 mm launchers. In use by Bulgaria and Romania. Offered for export.

Bulgarian 57 mm S-5KO HEAT/frag rocket
0004983

Canada

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
CRV7 C14, C15 and C16	70 mm	1.04 m (motor only)	6.6 kg (motor only)	various; see Note	in service	See Note
C17 and C18	70 mm	1.06 m (motor only)	5.8 kg (motor only)	various; see Note	in service	See Note

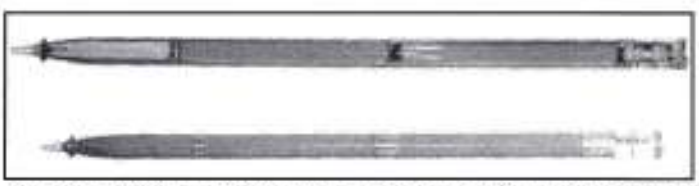
Note: Wide choice of 4.5 kg class warheads, including HE frag, HEISAP, smoke, illum, submunition, kinetic, HE and HE-I penetrators, AP and AT flechette, practice and training. Warheads are 0.36–0.79 m long and weigh 3.3–7.3 kg. Launchers have 4-, 6- or 19-tubes.



Canadian 70 mm CRV7/C15 rocket motors fitted with practice warheads (Peter Humphris)
0024962

China

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
Type 57-1/57-2	57 mm	0.91 m	3.99 kg	1.38 kg HE	in service	Fired from 8-, 12- or 18-tube launchers
Type 90-1 HE	90 mm	1.21 m	17.1 kg	7.88 kg HE	in service	Identical motor to HEAT Type 1
Type 90-1 HEAT	90 mm	1.27 m	14.6 kg	5.58 kg HEAT	in service	Identical motor to HE Type 1
122 mm HE	122 mm	2.87 m	67 kg	HE frag	in service	2-stage motor. Fuze incorporates delay options



Chinese 122 mm HE rockets. Note the 2-stage motor in the sectioned rocket (top) (INORINCO)
0007864

Chinese Type 90-1 HE rocket
0007865

Czech Republic

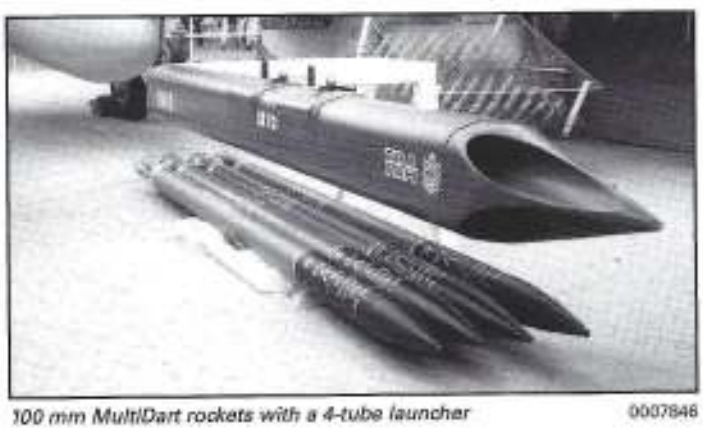
Designation	Calibre	Length	Weight	Warhead	Status	Remarks
LR-122	122 mm	1.94 m	46.2 kg	6.4 kg HE	in service	Similar to rocket fired from BM-21 MRL

France

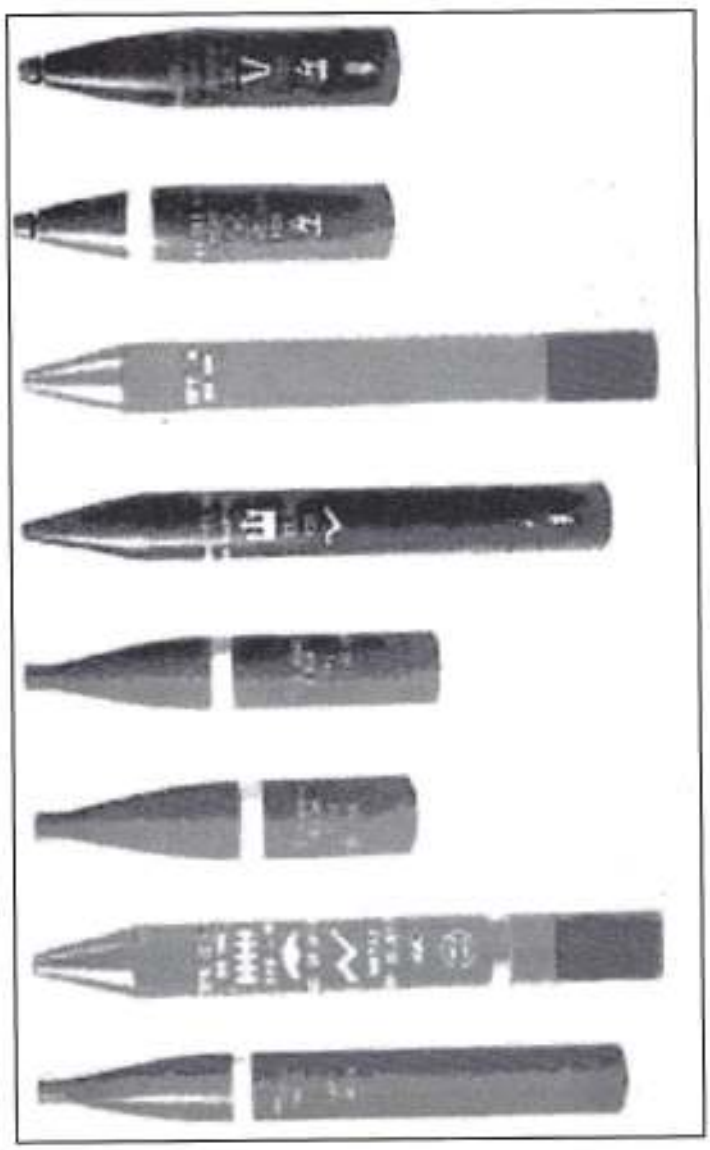
Designation	Calibre	Length	Weight	Warhead	Status	Remarks
SNEB 68	68 mm	0.91 m	5.0–6.2 kg	See *Remarks*	in service	Warhead options: HE, HEAT, kinetic penetrator darts, chaff, and training inert and training marker
SNEB 68 29 AMV	68 mm	1.6 m	6.4 kg	36 KE darts	in service	For helicopter use
TDA HE 100	100 mm	2.5 m	38 or 42 kg	Various 14 kg types	in service	Warhead options: HEAT frag, HE frag, HE penetrator and training marker
Multi-Dart 68	68 mm	1.4–1.5 m	8.2 or 8.3 kg	See *Remarks*	in service	Warhead options: multiple kinetic penetrator, illuminating, training inert and training marker
Multi-Dart 100	100 mm	2.74 m	38.6 to 40.5 kg	See *Remarks*	in service	3 types of multiple dart kinetic penetrator warheads

Note: 68 mm rockets can be fired from launchers with 6, 8, 12,18, 22 or 36-tubes. 100 mm rockets can be fired from launchers with 4, 8, 12, or 22-tubes.

French 68 mm SNEB rockets with practice warheads (Peter Humphris)
0007847



100 mm MultiDart rockets with a 4-tube launcher 0007846

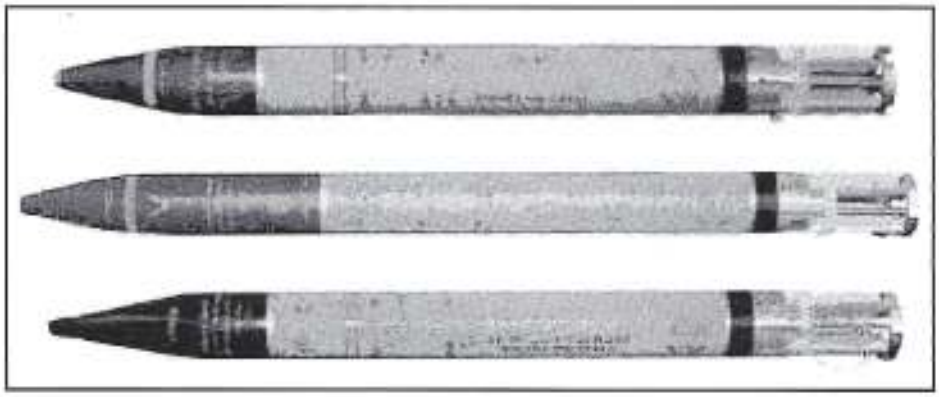


French 68 mm TDA rocket warheads: (from the top) HEAT, HE, submunition and multidart; the bottom four are training markers (TDA)
0085880

Greece

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
FFAR	68 mm	Approx 0.85 m	Approx 4 kg	HE, HEAT or practice	in service	Similar to French SNEB. Offered for export

Note: Launchers have 6, 7 or 19 tubes. Rockets may use the Mk 4 Mod 10 70 mm motor, which is manufactured in Greece to US military specifications and is compatible with a wide range of Hydra, CRV7 and FZ warheads.

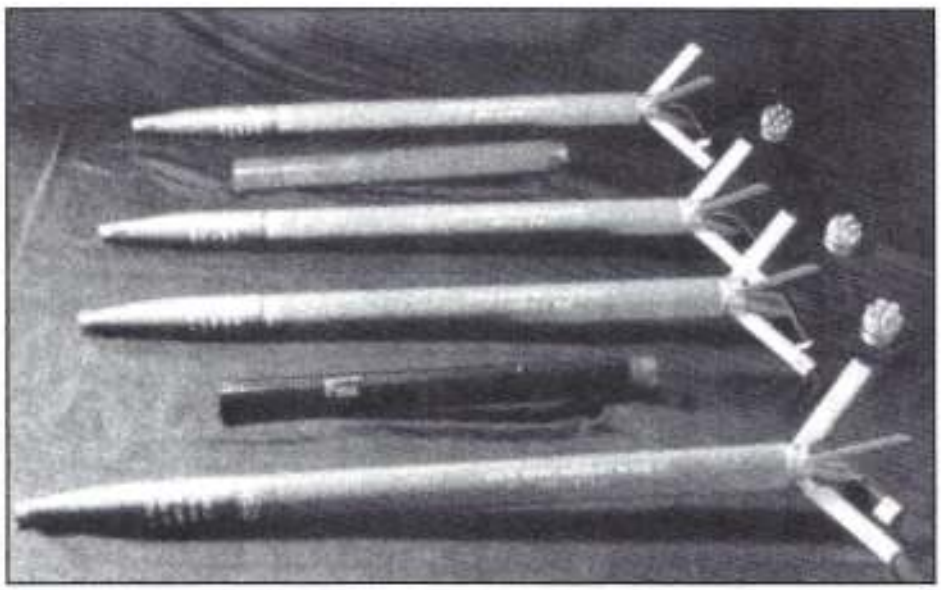


Greek 68 mm FFAR rockets: (from the top) HE, practice and HEAT (OMI)
0110161

Indonesia

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
Mk 4 Mod 10	70 mm (2.75 in)	1.3–1.8 m	7.7–11.2 kg	See Note	in service	Similar to US Mk 4
Mk 40 Mod 3	70 mm (2.75 in)	1.3–1.8 m	7.7–11.2 kg	See Note	in service	Similar to US Mk 40
FZ-67 Mod 1	70 mm (2.75 in)	1.3–1.8 m	7.9–11.4 kg	See Note	in service	Similar to Belgian FZ rockets
FZ-68 Mod 1	70 mm (2.75 in)	1.3–1.8 m	7.9–11.4 kg	See Note	in service	Similar to Belgian FZ rockets

Note: All of these Folding Fin Aircraft Rockets (FFAR) will accept the full range of FZ warheads (see entry for Belgium). Motors are 1 m long.



Indonesian FFAR 70 mm rockets
0007871

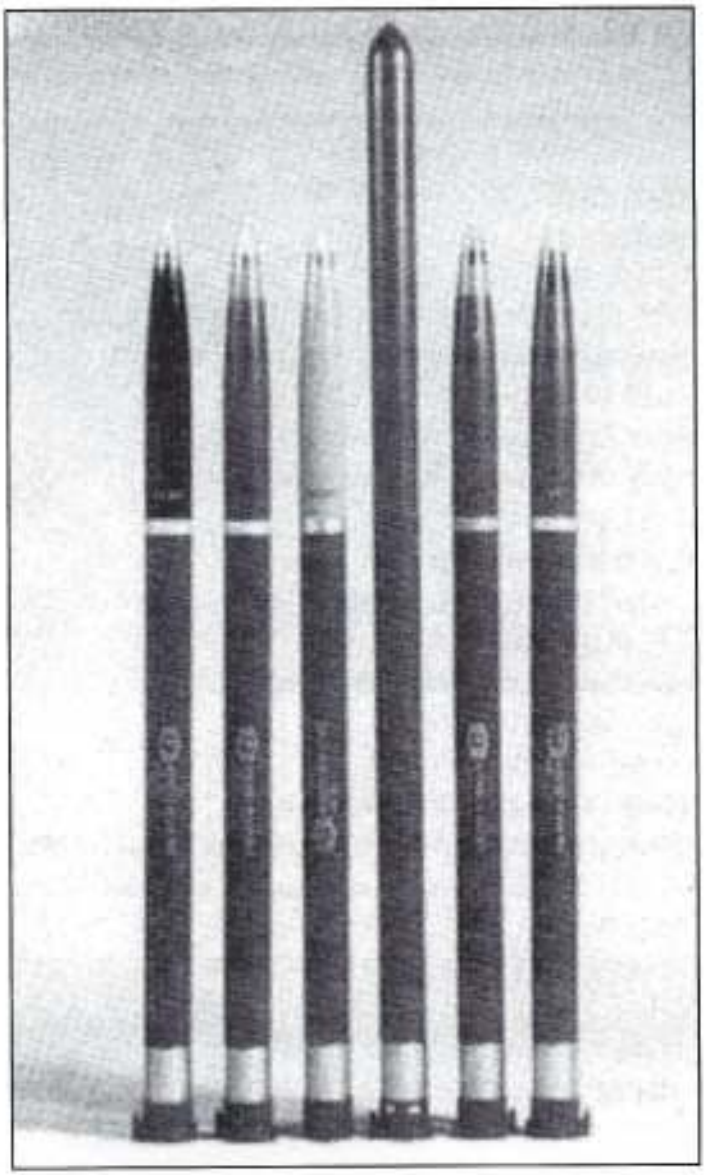
Iran

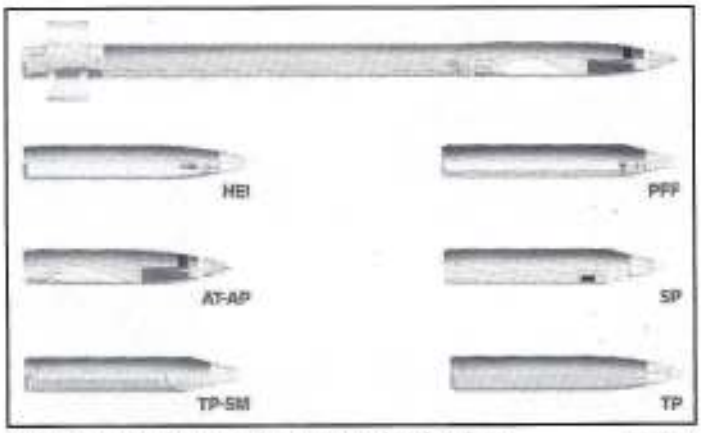
Designation	Calibre	Length	Weight	Warhead	Status	Remarks
ARASH	122 mm	Approx 2.8 m	Approx 65 kg	18 kg HE frag	in service	Variant of MRL rocket
SHAHIN 2	333 mm	3.9 m	530 kg	190 kg HE blast	in service	Also used in a surface-to-surface role

The 333 mm Shahin 2 rocket
0021055

Italy

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
SNIA BDP 51	51 mm (2 in)	1.02 m	4.8 or 5.6 kg	2.2 or 3 kg various types	in service	Choice of warheads, including HE, HEI, HEAT, spotting, AP frag, illum, chaff, practice. Fired from a variety of multitube launchers
SNIA BDP 81 mm 'Medusa' (conventional warhead)	81 mm	1.57 m	15 kg	7 kg various types	in service	Choice of warheads, including HE, HEAT, spotting, AP frag, practice. Fired from 6-, 7- or 12-tube launchers
SNIA BDP 81 mm 'Medusa' (submunition warhead)	81 mm	1.85 m	18 kg	AT or APAM submunitions	in service	Warheads weigh 10 kg and contain 11 submunitions. Fired from 6-, 7- or 12-tube launchers
SNIA BPD 'Falco' 122/A (conventional warhead)	122 mm	2.53 m	60 kg	HE and HEAT	in service	Warheads weighs 26 kg. Fired from a 4-tube launcher
SNIA BPD 'Falco' 122/A (submunition warhead)	122 mm	3.0 m	66 kg	AT or APAM	in service	AT has six bomblets and APAM has 77 bomblets.





Italian SNIA BPD 51 mm rocket and warhead options 0504760

Italian Medusa 81 mm rockets. The long warhead contains submunitions
0007875

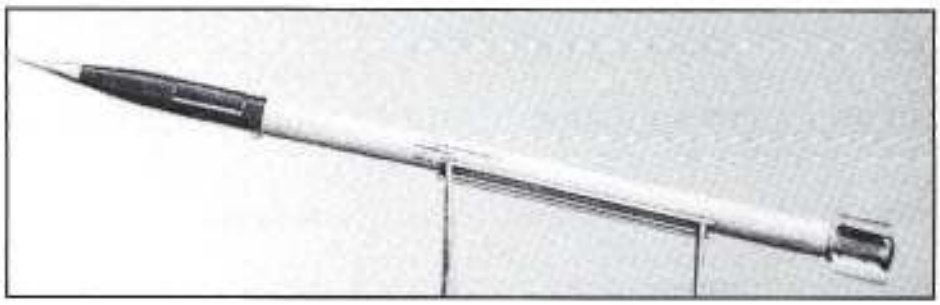
Italy (continued)

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
SNIA BPD 'Falco' 122/H (conventional warhead)	122 mm	2.72 m	58.4 kg	HE, smoke, WP and practice	in service	For helicopter use. Fired from 3- or 6-tube launchers
SNIA BPD 'Falco' 122/H (submunition warhead)	122 mm	3.34 m	71.4 kg	77 × APAM, 6 × AT or 66 × AP mine	in service	For helicopter use. Fired from 3- or 6-tube launchers. AP mine option is now withdrawn

Romania

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
M21-OF	122 mm	2.87 m	65.4 kg	18.4 kg HE frag (6.3 kg HE)	in service	Offered for export
M21-OF-S	122 mm	1.93 m	46.6 kg	18.4 kg HE frag	in service	M21-OF with shorter motor. Offered for export

Note: Warheads may use the MRV-U fuze (instant, short or long delay), or Forad 1 proximity fuze, which can function up to 20 m.



Romanian 122 mm M21-OF rocket fitted with fragmentation warhead and proximity nose fuze
(ROMARM)
0085873

Russian Federation

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
ARS-212	212 mm	n/k	116 kg	n/k	obsolete	May be in use with other countries
M-100	137 mm	n/k	15.6 kg	HE	obsolete	May be in use with other countries

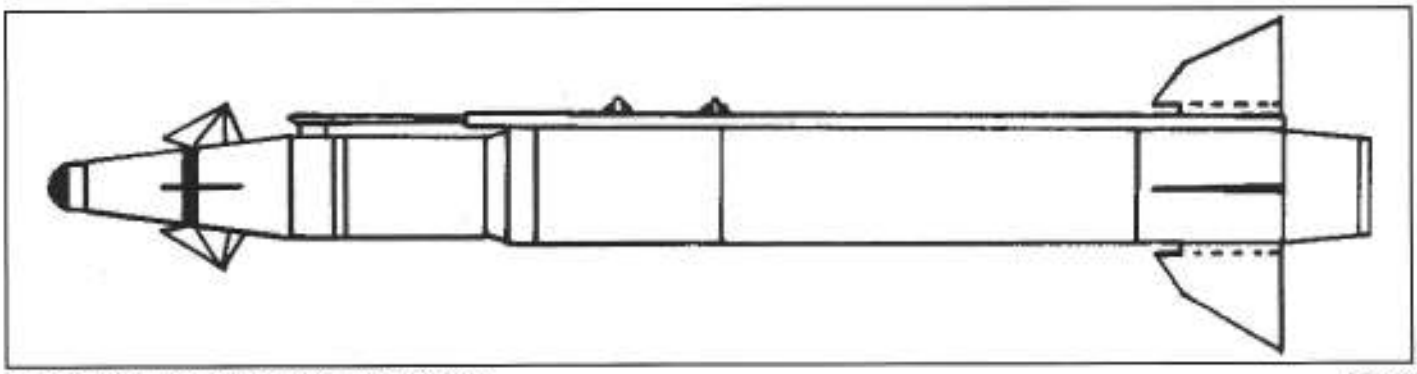
Russian 57 mm S-5KO HEAT/fragmentation rockets
(Colin King)
0074655

Russian 80 mm S-8 rockets: S-8KO (above), S-8B (below)
(Colin King)
0074656

Russian Federation (continued)

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
S-5 series	57 mm	1 m	4 kg	9 types	in service	Choice of warheads, including HE, frag, HEAT, illum, chaff, practice. See *Note 1*
S-8B, BM	80 mm	1.54 m	15.2 kg	7.41 kg HE	in service	Blast 'demolition' or concrete-piercing warhead. See *Note 2*
S-8D, DM, DF	80 mm	1.7 m	11.6–13.4 kg	3.8–5.5 kg FAE	in service	FAE warheads, contain 2.15–3.3 kg fuel. See *Note 2*
S-8KO, KOM	80 mm	1.57 m	11.3 kg	3.6 kg HEAT (0.9 kg HE)	in service	Anti-tank/fragmentation warhead. See *Note 2*
S-8O, OM	80 mm	1.63 m	12.1 kg	4.3 kg illuminating	in service	30 second burn time. See *Note 2*
S-8P	80 mm	1.63 m	12.3 kg	4.5 kg chaff	in service	
S-8T	80 mm	1.68 m	15 kg	6.6 kg tandem HEAT (1.6 kg HE)	in service	Tandem HEAT warhead for defeating reactive armour. See *Note 2*
S-13	122 mm	2.54 m	57 kg	21 kg	in service	Concrete penetrator warhead contains 1.82 kg HE. See *Note 3*
S-13B	122 mm	2.9 m	60 kg	23 kg	in service	Penetrator warhead contains 1.92 kg HE. See *Note 3*
S-13T	122 mm	3.1 m	75 kg	21 kg and 16.3 kg	in service	Tandem warhead penetrator. See *Note 3*
S-13-OF	122 mm	2.9 m	69 kg	33 kg APAM	in service	Anti-personnel and anti-material warhead contains 7 kg HE. See *Note 3*
S-13D, DF	122 mm	3.12 m	68 kg	32 kg FAE	in service	FAE warhead contains 14.6 kg fuel. See *Note 3*
S-16	160 mm	n/k	n/k	n/k	in service	Used with 'Hind' helicopter
Si-21	220 mm	n/k	n/k	n/k	in service	
S-24B	240 mm	2.22 m	232 kg	125 kg HE frag	in service	
S-25C, O	266 mm	3.76 m	385 kg	151 kg HE	in service	Rail-launched
S-25LD	340 mm	4.09 m	409 kg	150 kg penetration	in service	Rail-launched
S-25OF, OFM	266 mm	3.56 m	380 kg	150 kg HE	in service	Rail-launched

Note 1: S-5 launchers are cylindrical and aerodynamic, with 8-, 16-, 19 or 32 tubes.
Note 2: There are two types of S-8 launchers (for helicopters and fixed-wing aircraft), both with 20 tubes.
Note 3: There are two types of S-13 launchers (for helicopters and fixed-wing aircraft), both with 5 tubes.



The S-25LD is a laser-seeking variant of the S-25OF 0054587

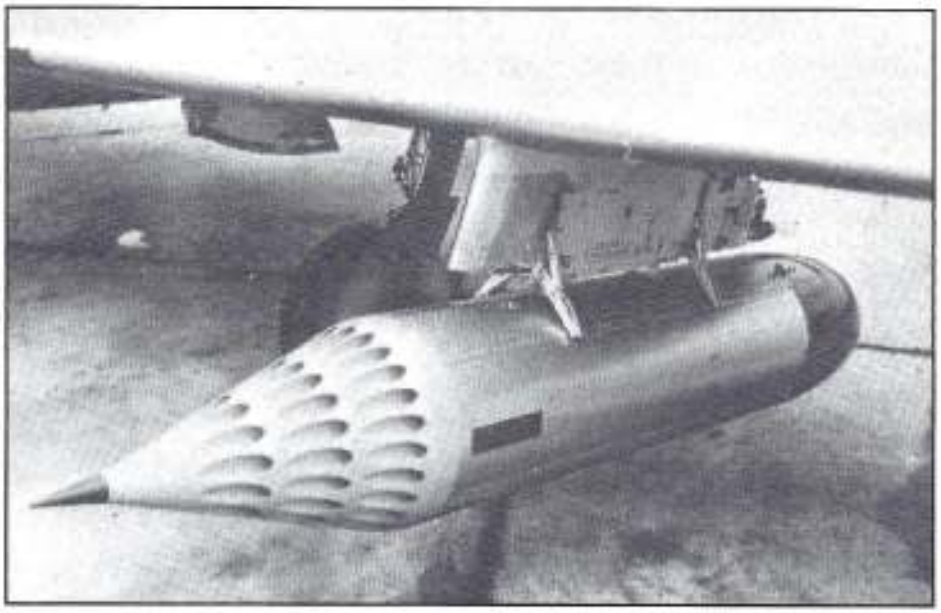
S-5 launchers: UB-32-57 (left) and UB-16-57 (centre and right). Note the rockets still in the 16-tube launchers
(Ollie Allerhead)
0569608

Serbia

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
VRZ-57	57 mm	n/k	n/k	HE or HEAT	In service	12 rockets fired from Lanser L57 pod
VRZ-127	127 mm	n/k	n/k	HE or HEAT	In service	

Spain

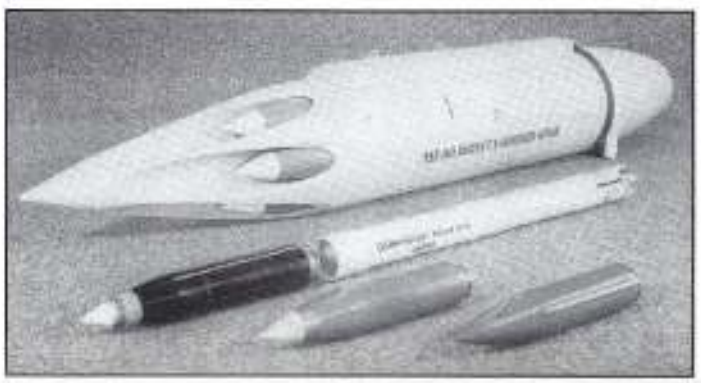
Designation	Calibre	Length	Weight	Warhead	Status	Remarks
S-9	37 mm	n/k	n/k	n/k	in service	CASA launchers fire 18 or 54 rockets
S-11	70 mm	n/k	n/k	n/k	in service	CASA launchers fire 6 or 18 rockets
S-12	100 mm	n/k	n/k	n/k	in service	CASA launcher fires 6 rockets



CASA 54-tubelauncher for S-9 rockets
0007893

Sweden

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
M-49 PSRAK	145 mm	n/k	n/k	HEAT	in service	Fired singly
M-56	135 mm	n/k	42 kg	fragmentation or blast	in service	Fired singly or in pods of 6 rockets
M-57	75 mm	n/k	7 kg	HEAT, fragmentation or blast	in service	Fired singly or in pods of 19 rockets
M-60	135 mm	n/k	42 kg	HE	in service	Fired singly or in pods of 6 rockets
M70 (General purpose HE)	135 mm	2.1 m	46 kg	21 kg GP (3.7 kg HE) and Practice	in service	
M70 (AP frag)	135 mm	2.16 m	45 kg	20 kg AP/ fragmentation (5 kg HE)	in service	

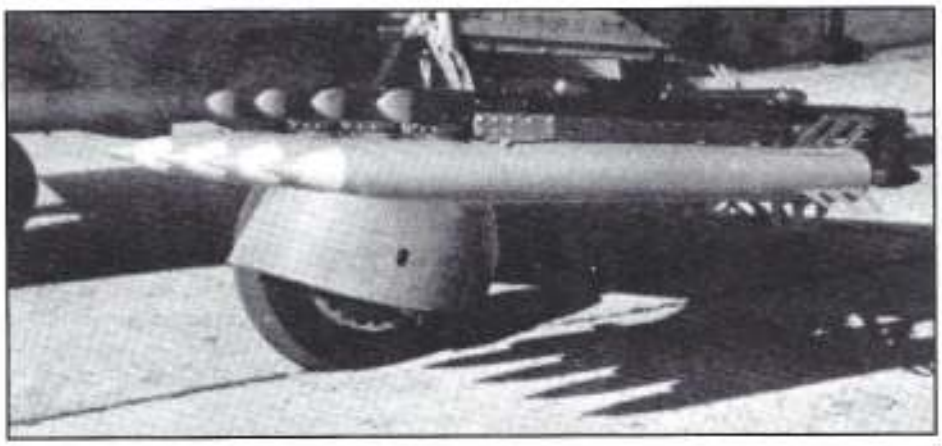


Swedish 135 mm M70 rocket, launcher, and warhead options
0504768

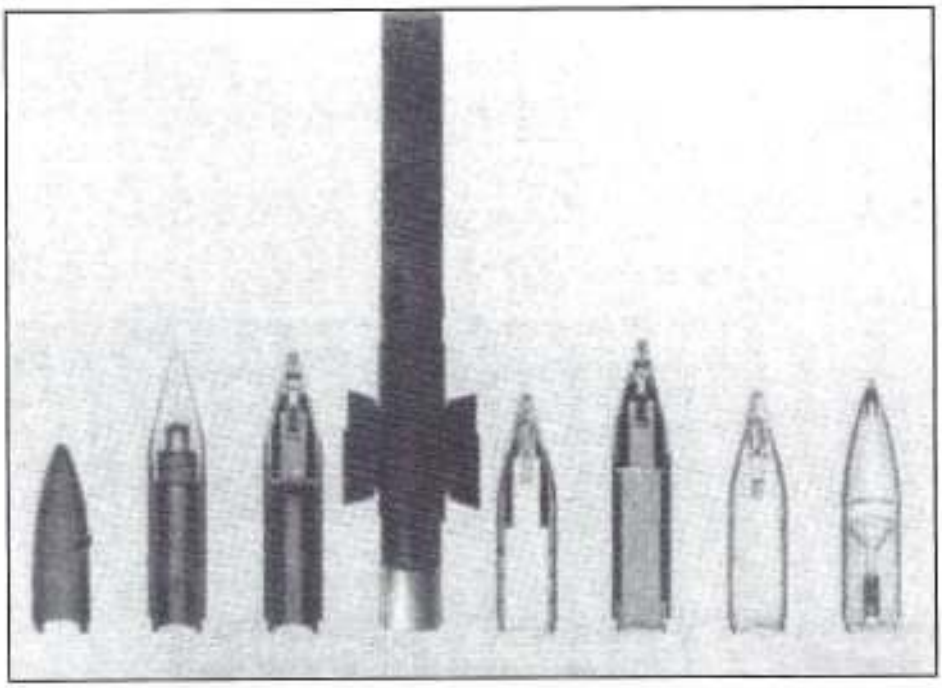
Switzerland

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
SNORA RAK 022	81 mm	1.55 m	15.7 kg	7 kg inert	in service	Practice warhead
SNORA RAK 023	81 mm	1.41 m	13.2 kg	4.5 kg HE/frag (1 kg HE)	in service	Anti-personnel warhead with 702 ball fragments
SNORA RAK 024	81 mm	1.55 m	15.7 kg	7 kg HE/frag (1.7 kg HE)	in service	Anti-personnel warhead with 1,215 ball fragments
SNORA RAK 025	81 mm	1.78 m	19.7 kg	11 kg HE/frag (2.8 kg HE)	in service	Anti-personnel warhead with 2,133 ball fragments
SNORA RAK 026	81 mm	1.51 m	13.2 kg	4.5 kg HEAT (1 kg HE)	in service	HEAT warhead with electromechanical fuze
SNORA RAK 027	81 mm	1.78 m	19.7 kg	11 kg practice	in service	Fitted with a UGK 034 practice warhead
SNORA RAK 029	81 mm	1.43 m	13.2 kg	4.5 kg practice	in service	Fitted with a USK 035 practice warhead
SNORA RAK 030	81 mm	1.55 m	15.7 kg	11 kg practice	in service	Target practice and marker warhead
SNORA RAK 031	81 mm	1.78 m	19.7 kg	11.5 kg practice	in service	Fitted with a USK 037 practice warhead
SNORA RAK 054	81 mm	1.5 m	13.2 kg	4.5 kg HEAT (1 kg HE)	in service	HEAT warhead with electromechanical fuze
SURA-D RAK 047	81 mm	1.2 m	11.4 kg	3 kg HEAT	in service	
SURA-D RAK 048, 049	81 mm	1.21 m	12.4 kg	4.5 kg practice	in service	
SURA-D RAK 050	81 mm	1.2 m	12.4 kg	4.5 kg HE frag	in service	
SURA-D RAK 051	81 mm	1.08 m	11.4 kg	3 kg practice	in service	
SURA-D RAK 052	81 mm	1.14 m	11.4 kg	3 kg HE incendiary	in service	
SURA-D RAK 053	81 mm	1.14 m	11.4 kg	3 kg HE frag	in service	

Note: SNORA rockets are fired from 6-, 7- or 12-tube launchers; a 4-rocket rack is also available. SURA-D rockets are suspended from racks or NATO suspension mountings.



Swiss SNORA 81 mm rockets mounted on a rack; note the fixed tailfins
0007882



SURA-D rocket motor with warhead options
0007891

United Kingdom

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
RO 2 inch	50 mm (2 in)	1.29 m	4.32 or 4.54 kg	HE, fragmentation or practice	Withdrawn from operational service in early 1990s	Exported versions may still be in service

The obsolete British 2 in rocket
(Colin King)
0532019

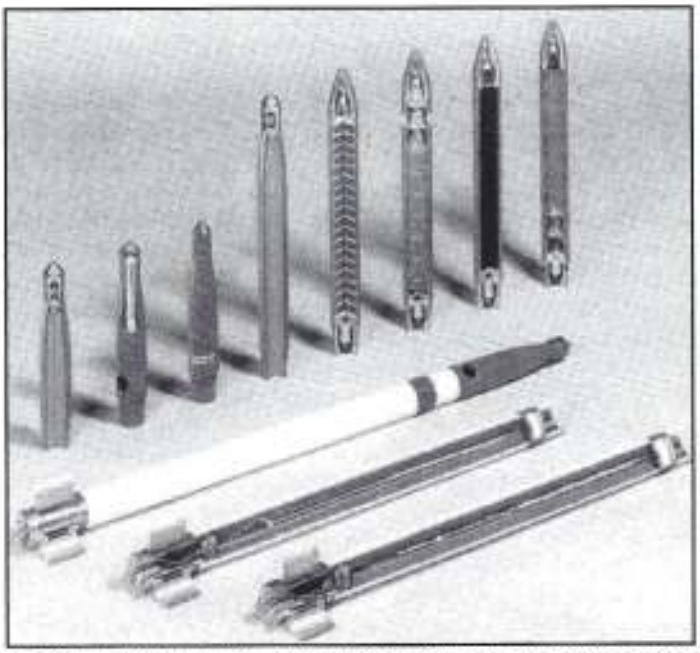
United States

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
Hydra 70 (M151)	70 mm	1.39 m	10.6 kg	HE frag	in service	warhead contains 1.04 kg HE
Hydra 70 (M229)	70 mm	1.74 m	13.8 kg	HE frag	in service	warhead contains 2.2 kg HE
Hydra 70 (M255)	70 mm	1.74 m	11.9 kg	flechette	in service	585 × 120 g or 1,200 × 60 g flechettes

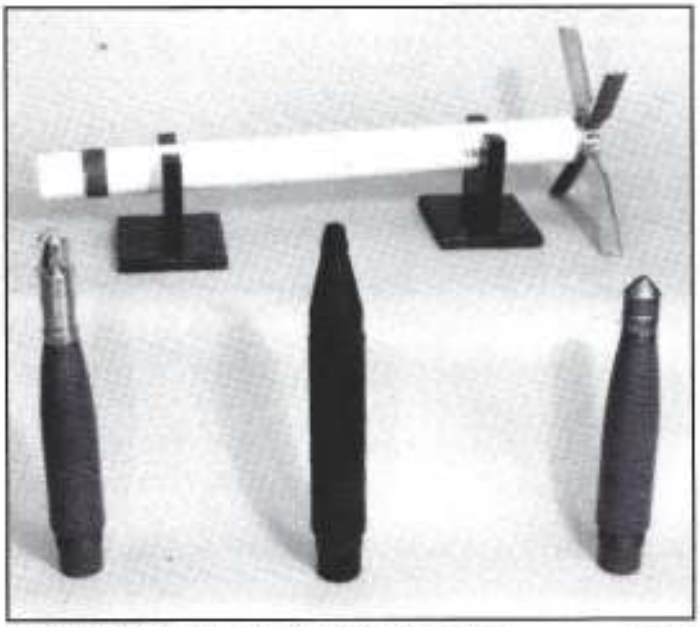
United States (continued)

Designation	Calibre	Length	Weight	Warhead	Status	Remarks
Hydra 70 (M257)	70 mm	1.79 m	10.9 kg	illuminating	in service	120 s burn time
Hydra 70 (M261)	70 mm	1.74 m	12.3 kg	submunition	in service	dispenses 9 × M73 submunitions
Hydra 70 (M264RP)	70 mm	1.74 m	10 kg	smoke	in service	bursting warhead with 72 red phosphorus wedges
Hydra 70 (M267)	70 mm	1.74 m	12.3 kg	practice submunition	in service	dispenses 6 × inert and 3 × pyrotechnic marker submunitions
Hydra 70 (M274)	70 mm	1.47 m	10.4 kg	practice	in service	pyrotechnic flash warhead
Hydra 70 (WTU-1/B)	70 mm	1.47 m	10.9 kg	practice	in service	inert warhead
Mk 4 and Mk 40	70 mm	1.37 m	13.6 kg	various	no longer in service with the US, but manufactured under license by Greece and Indonesia	Warhead options include HEAT, blast/fragmentation, WP smoke and practice. Used in Vietnam and widely exported
Persuader	70 mm	1.06 m	10.9 kg	flechette	believed to be in development	Interchangeable with Hydra 70

Note: Rockets are normally fired from 7- or 19-tube launchers, but are compatible with some other multitube launch systems.



US 70 mm Hydra rockets and warheads. Warheads are (from the left): M151 (HE APAM), M274 (smoke), WTU-1/B (practice), M229 (HE APAM), M264 (red phosphorus smoke), M267 (submunition practice), M255A1 (flechette) and M261 (dual-purpose submunition) 0007889



US Mk 40 motor with compatible warheads (Thiokol) 0007886

SUBMUNITIONS

Argentina

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
n/k	HEAT/frag	impact	250 g	85 mm (est)	40 mm (est)	in service	M42-type DPICM delivered by artillery projectile

Bosnia-Herzegovina

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
KB-1	HEAT/frag with ball bearing fragmentation sleeve	impact	210 g	80 mm	40 mm	See Note	DPICM delivered by 262 mm artillery rocket
KB-2	HEAT/frag	impact	250 g	80 mm	40 mm	See Note	Similar to M42
KB-PTM	Misznay Schardin, 680 g HE	magnetic influence	1.7 kg	110 mm	100 mm	development cancelled	Anti-vehicle mine developed for 'Orkan' MRL. Reached early stages of production but not fielded

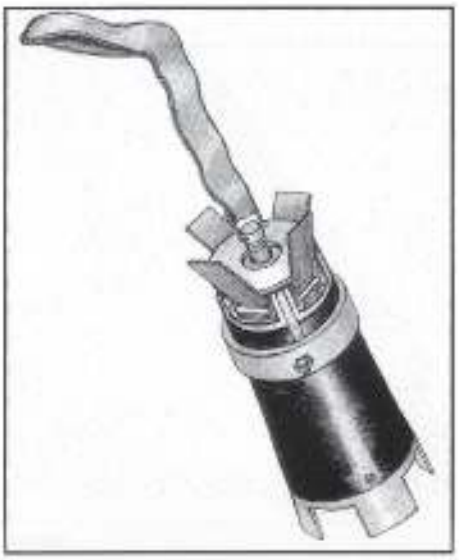
Note: No longer in production. Banned and due for destruction under the terms of the 2008 Cluster Munitions Convention (CCM).

The KB-PTM anti-tank mine was never fielded (Colin King) 0576671

The KB-1 submunition (Colin King) 1041006

Brazil

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
Astros II	HEAT/frag	impact	n/k	203 mm	70 mm	in service	delivered by Astros II MRL rockets; 180 mm SS-40 (20 bomblets) or 300 mm SS-60 (65 bomblets)

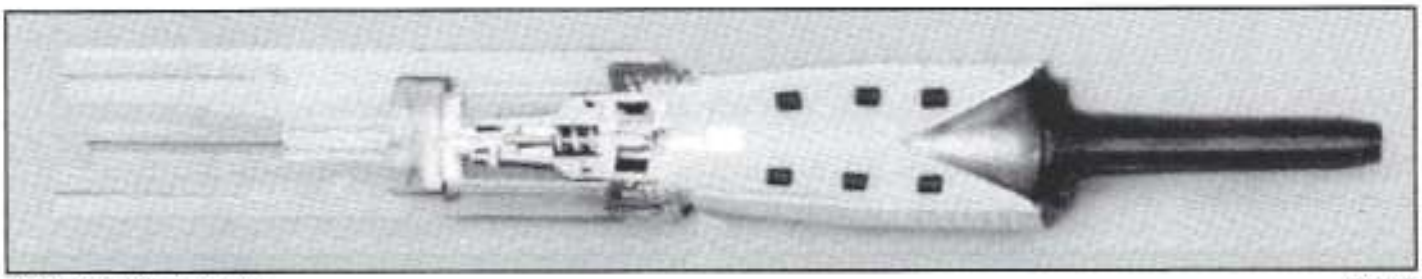


Astros II submunition
0546814

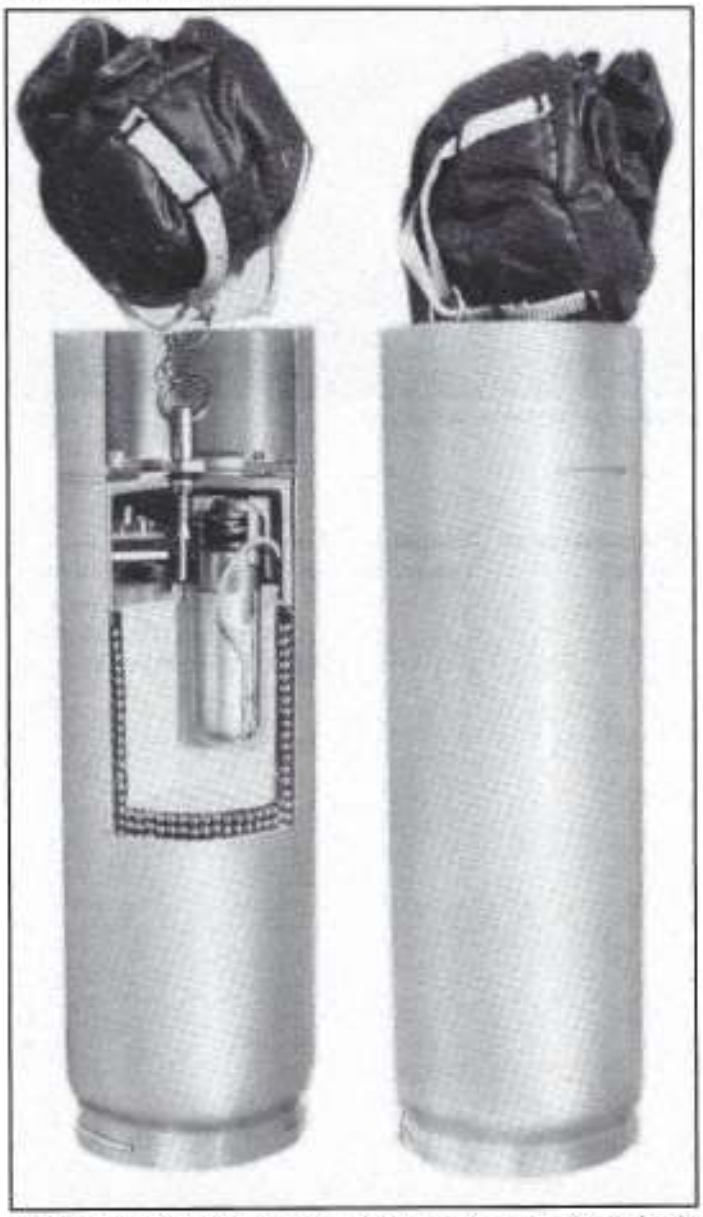
Chile

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
PM-1 bomblet	HEAT/frag: 0.15 kg HE	impact	0.80 kg	0.38 m	48 mm	See Note	used in CB-130, CB-500 and CB-250K. Found in Sudan
PM-2 bomblet	HEAT/frag/ incendiary: 0.15 kg HE with 0.01 kg Zirconium	impact	0.79 kg	0.38 m	48 mm	See Note	used in CB-500K-2
PM-3 bomblet	HE frag: 0.59 kg HE with 0.014 kg incendiary	delay and anti-disturbance	2.20 kg	0.23 m	76 mm	See Note	area denial bomblet used in CB-770
WASP bomblet	0.13 kg HEAT or 0.15 kg frag	impact	0.7 kg	0.38 m	53 mm	See Note	used in WB-250-F and WB-500-F CBs

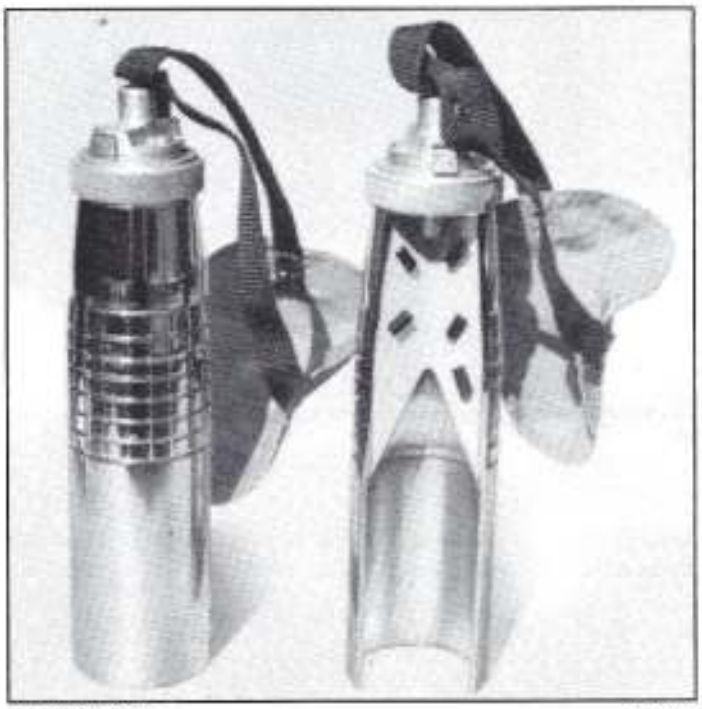
Note: No longer in production. Banned and due for destruction under the terms of the 2008 Cluster Munitions Convention (CCM)



A Sectioned PM-1 bomblet 0504438



PM-3 bomblets. Note the fragmentation around the charge in the sectioned model 0504445



PM-2 bomblets 0504442

PM-1 (Colin King) 1041007

China

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
5 kg Type 1	HE frag: 0.50 kg HE	impact	4.34 kg	0.38 m	65 mm	in service	high drag bomblet
AT bomblet	HEAT/frag (765 steel balls)	impact	n/k	n/k	n/k	in service	189 used in 340 kg bomb
FAE bomblet	enhanced blast; FAE	proximity and SD	n/k	n/k	n/k	in service	310 kg cluster bomb contains 3 bomblets
Bomblet (anti-runway)	2-stage attack cratering warhead	impact and short delay	20 kg	0.6 m	150 mm	in service	
Bomblet (anti-tank)	HE shaped charge, rocket-assisted	IR sensor	4.5 kg	0.22 m	135 mm	in service	350 kg cluster bomb contains 16 bomblets
MZD-2	HEAT/Frag	impact	214 (est)	85 mm (est)	39 mm (est)	in service	dispensed using artillery projectiles and rockets. Found in Lebanon
Type 81	HEAT/Frag (29.5 g RDX)	impact	214 g	90 mm (est)	39 mm	in service	dispensed using artillery projectiles and rockets. Found in Iraq and Lebanon
Type 90	HEAT/Frag	impact	n/k	n/k	40 mm	in service	dispensed using artillery projectiles and rockets

The Chinese MZD-2
(Colin King)
1310629

The Chinese Type 81 has been found in Iraq and Lebanon
(George Zahaczewsky) 1198853

Czech Republic

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
Trovnik	HEAT/frag (40 g Composition A5)	impact	350 g	62.5 mm	44 mm	See Note	M42-type DPICM delivered by Trnovnik artillery projectile

Note: No longer in production. Banned and due for destruction under the terms of the 2008 Cluster Munitions Convention (CCM). The Slovakian AGAT submunition is also used by the Czech Republic in 122 mm rocket warheads, each containing 56 bomblets. For more information on the AGAT, see separate entry for Slov*akia*.

France

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
BM 400 submunitions	HE frag	impact	100 kg	0.6 m	300 mm	in service	3 carried in BM 400 cluster bomb. Fuze has 700 mm nose probe
BLG 66 Belouga EG grenade	HE frag	impact	1.3 kg	0.153 m	66 mm	See Note	151 carried in BLG 66 'Belouga' cluster bomb

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France (continued)

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
BLG 66 Belouga AC grenade	HEAT	impact	1.3 kg	0.153 m	66 mm	See Note	151 carried in BLG 66 'Belouga' cluster bomb
BLG 66 Belouga IZ grenade	HE frag	variable delay	1.3 kg	0.153 m	66 mm	See Note	151 carried in BLG 66 'Belouga' cluster bomb
CASCAD submunitions	HE frag	impact	90 kg	0.6 m	300 mm	n/k	3 carried in CASCAD Mk 1 cluster bomb. Fuze has 1 m nose probe
F1 DPICM	HEAT/Frag (32 g RDX/ wax)	impact/SD	244 g	90 mm (est)	40 mm	See Note	63 carried in 155 mm OGRE F1 projectile. Self destruct operated after 17 s
TDA grenade	HEAT	impact	1.60 kg	0.19 m	70 mm	See Note	Launched using 74 mm cartridge. Used in Alkan dispensers
Type 314 grenade	HE frag	delay (airburst)	3 kg	0.213 m	70 mm	See Note	Launched using 74 mm cartridge. Used in Alkan dispensers

Note: No longer in production. Banned and due for destruction under the terms of the 2008 Cluster Munitions Convention (CCM).

TDA anti-armour submunition and launch cartridge
0001983

Belouga submunitions, from the left: 'EG' fragmentation; 'AC' anti-tank; 'IZ' delay-fuzed 'interdiction' model
0504470

The F1 DPICM (Colin King)
1041008

Germany

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
DM 1383	HEAT/frag	impact/SD	300 g (est)	90 mm (est)	42 mm	See *Note 1*	German designation for Israeli M85 DPICM
DM 1385	HEAT/frag	impact/SD	296 g	85 mm	42 mm	See *Note 1*	German SD DPICM used in 155 mm projectiles
KB 44	HEAT/frag	impact	0.58 kg	0.27 m	44 mm	See *Note 1*	Carried by MW-1, MDS and DWS 24/39; see *Note 2*
MIFF	anti-armour (2 × MS plates)	seismic/ magnetic influence	3.4 kg	0.1 m	132 mm	See *Note 1*	Anti-tank mine carried by MW-1, MDS and DWS-24/29; see *Note 2*
MUSA	HE frag	delay	4.5 kg	0.13 m	132 mm	See *Note 1*	Area denial bomblet carried by MW-1, MDS and DWS 24/39; see *Note 2*
MUSJAS 2	HE frag; multiple MS plates	proximity	n/k	n/k	132 mm	See *Note 1*	Carried by MW-1, MDS and DWS 24/39; see *Note 2*

Germany (continued)

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
MUSPA	HE frag	acoustic proximity	4.5 kg	0.13 m	132 mm	*See Note 1*	Same as the MUSA, but uses an acoustic fuze for runway denial operations
SMART 155	MS with Tantalum plate	IR/Radar scanning	n/k	n/k	140 mm (est)	in service	German designation DM 702. Two delivered in a 155 mm projectile. Also manufactured under license in the US
SMART-D (AM)	Projected fragmentation (Tungsten balls)	IR/Radar scanning	n/k	n/k	140 mm (est)	in service	Two delivered in a 155 mm projectile
STABO	HE tandem	impact	16 kg	0.6 m	132 mm	in service	2-stage attack runway penetrator. Carried by MW-1, MDS and DWS-24/39; see *Note 2*

Note 1: No longer in production. Banned and due for destruction under the terms of the 2008 Cluster Munitions Convention (CCM).
Note 2: Dispenser Weapon System 24 (DWS 24) is a derivative of the Modular Dispenser System (MDS). DWS 39 is the Swedish variant. See production tables for *Cluster bombs and dispensers.*

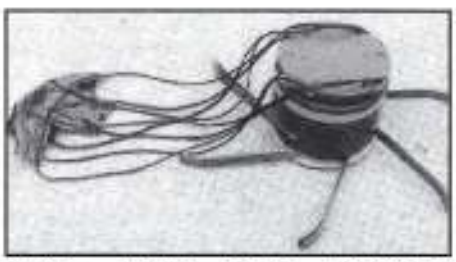
KB-44 anti-armour submunition 0504506

MIFF anti-armour mine 0074544

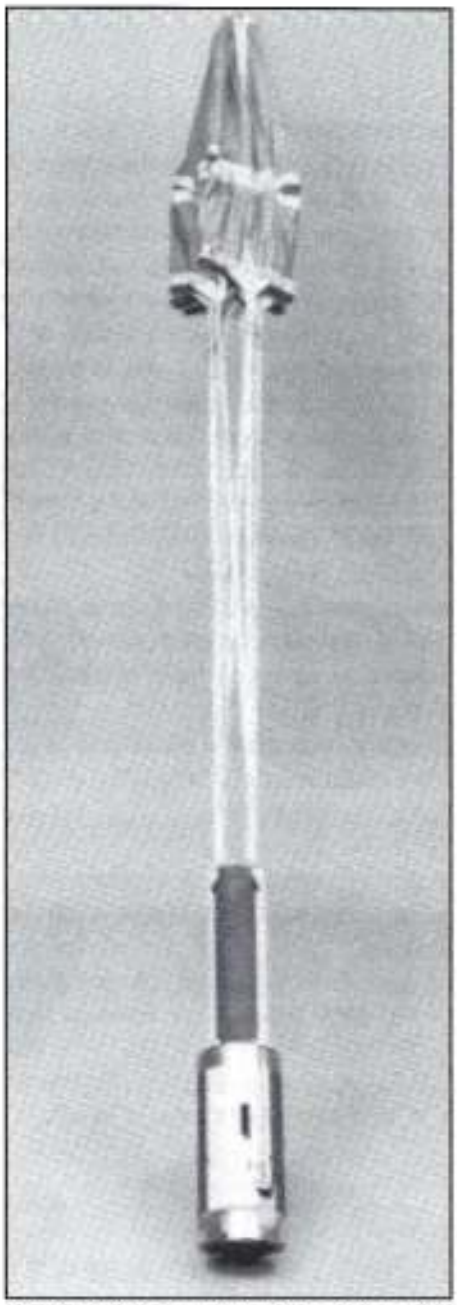
DM 1383 is a DPICM with pyrotechnic SD (Colin King) 1329654

DM 1385 is the German designation for the Israeli M85 (Colin King) 1198854

MUSA delay-fuzed submunition 0504508



MUSPA runway denial submunition (Rheinmetall) 0056178



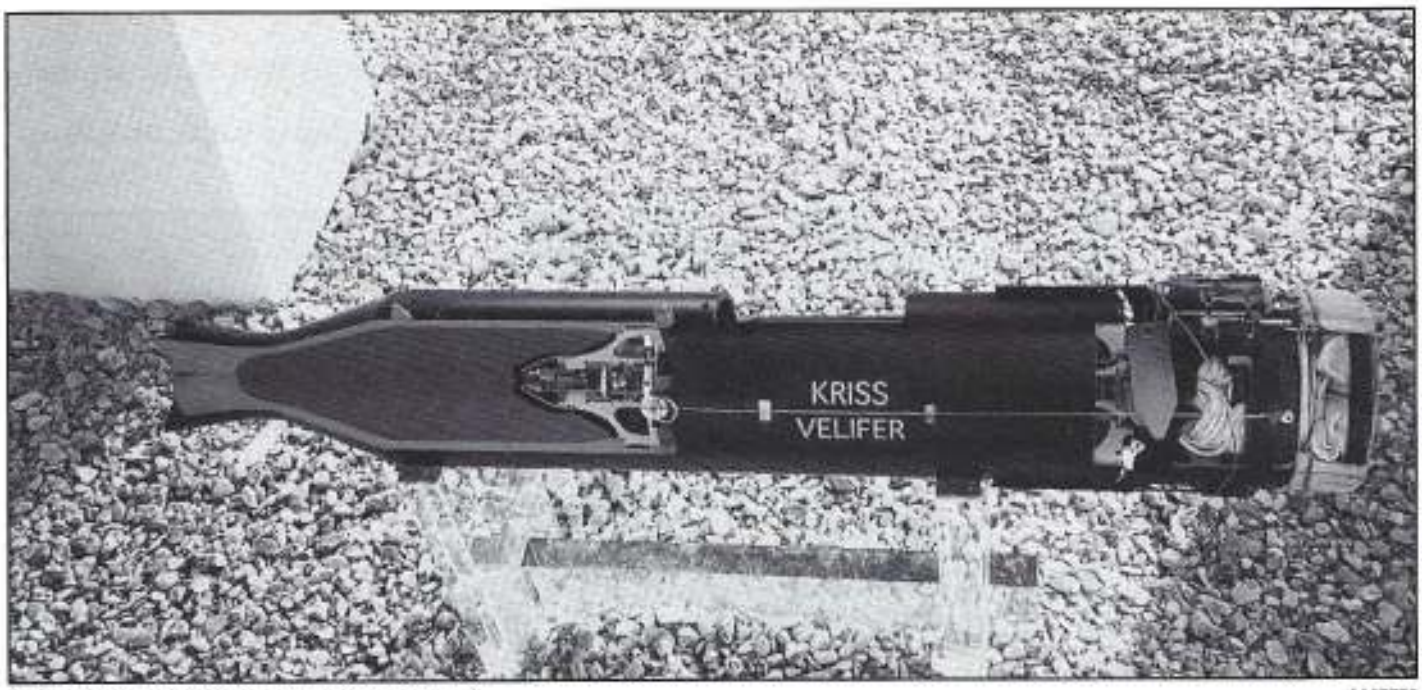
STABO 2-stage runway attack submunition 0504510

Greece

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
GM 1	HEAT/frag (40 g Composition A5)	impact	290 g (est)	85 mm (est)	40 mm (est)	in service	M42-type DPICM delivered by artillery projectile

International

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
ADM	HE frag	acoustic/ random self-destruct	4.5 kg	125 mm	132 mm	entering service; see *Note 1*	area-denial bomblet for use in the AFDS (see *Note 2*)
AMS/-1/-2	HE frag	AMS: delay. AMS-1 and 2: proximity	4.5 kg	125 mm	132 mm	entering service; see *Note 1*	similar to ADM but with a choice of 3 different fuzes
ATM	2 × Misznay Schardin	seismic/ magnetic influence	3.4 kg	100 mm	132 mm	entering service; see *Note 1*	anti-tank ground mine for use in the AFDS



A sectioned KRISS submunition (Peter Humphris) 0007772

The M42 DPICM is externally identical to the M46 (Colin King) 1047739

Sections of submunitions (not to scale) for use with the Autonomous Free-flight Dispenser System (AFDS) (DASA)
0051992

International (continued)

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
KRISS	HE cratering	impact and variable delay	52 kg	n/k	n/k	entering service	rocket-propelled runway penetration bomblet. 10 carried in Apache missile
M42	HEAT/frag	impact	210 g	80 mm	40 mm	in service; see *Note 1*	see *Note 3*
M46	HEAT/frag	impact	213 g	80 mm	40 mm	in service; see *Note 1*	see *Note 3*
RCB	HE tandem	impact	16 kg	0.6 m	132 mm	entering service	runway penetration bomblet for use in the AFDS (see *Note 2*)
SB 44	HEAT/frag	impact	0.58 kg	270 mm	44 mm	entering service; see *Note 1*	fragmentation bomblet for use in the AFDS (see *Note 2*)

Note 1: Illegal for use by signatories to the Cluster Munitions Convention (CCM).
Note 2: For details of the Autonomous Free-flight Dispenser System (AFDS) see the tables for *Cluster bombs and dispensers*.
Note 3: M42 and M46 are standard DPICM delivered using artillery rockets and projectiles. Both are externally identical, but the M46 has a thicker side wall and no internal grooving; these submunitions do not incorporate self-destruct features. They are used by several countries, including Egypt, the Netherlands, Pakistan, Turkey and the US.

Israel

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
Hornet 5	HEAT/frag (17.5 g RDX or PBX W-11)	impact/SD	155 g	55 mm (est)	31 mm	in service	Updated, smaller version of the M85 for use in 105 mm projectiles
M79 (see *Remarks*)	HEAT/frag (44 g RDX)	Impact	290 g (est)	85 mm	42 mm	in service	M79 is believed to be the designation for the non-SD variant of the M85
M85	HEAT/frag (44 g RDX)	impact/SD	296 g	85 mm	42 mm	in service	Sometimes known as 'Bantam'
M87	HEAT/frag (44 g RDX)	impact/SD	250 g (est)	70 mm (est)	42 mm	in service	Variant of the M85 for use in mortars

Notes: Hornet 5 and M85 incorporate a pyrotechnic self-destruct delay of 15 seconds from arming. All bomblets except M87 are artillery delivered.

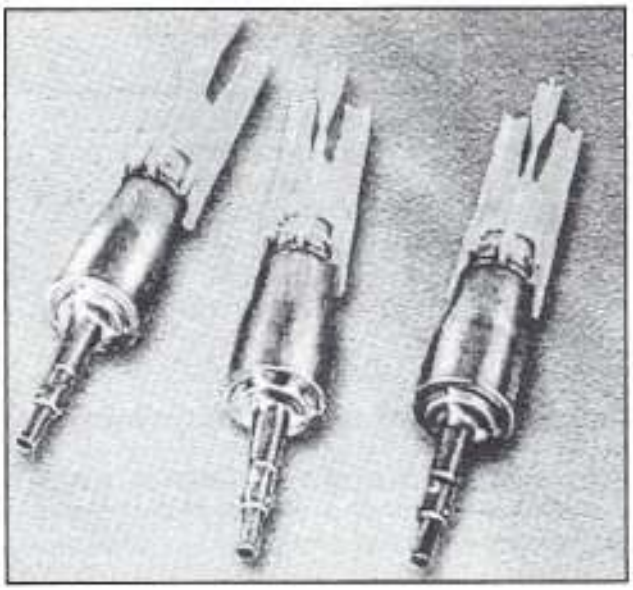
The Israeli M85 is used in Germany under the designation DM 1385 (Colin King) 1198854

The Hornet 5 DPICM 0623892

Pakistan

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
Hijara	HEAT/frag: 180 g RDX/TNT	impact	0.6 kg	321 mm	53 mm	in service	Copied from US Mk 118 'Rockeye'. Carried by PSD-1 (225 bomblets) and TSD-1 (247 bomblets) cluster bombs

Note: Pakistan also produces M42 and M46 DPICM for use in artillery projectiles. These are listed under *International*.



The Hijara bomblet is a copy of the US Mk 118 'Rockeye' (NDC)
0106144

Poland

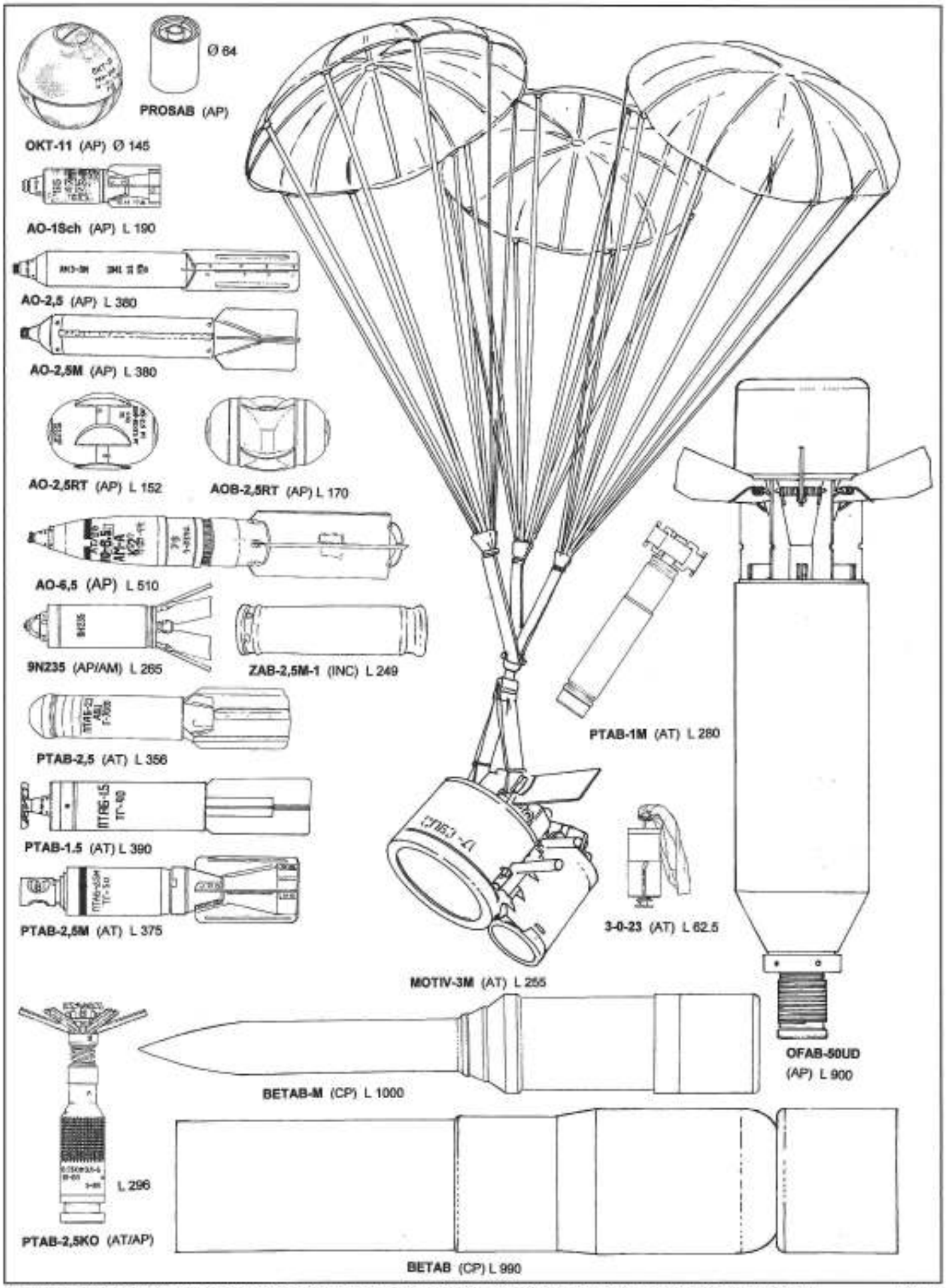
Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
LBOk-1 bomblet	HE with ball-bearing frag	impact	0.8 kg	170 mm	67 mm	in service	315 carried in ZK-300 'Kisajno' cluster bomb

Romania

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
Dual-purpose grenade	HEAT/frag (44 g HE)	impact with self-destruct	290 g	56 mm	42 mm	in service	DPICM dispensed from carrier projectiles

Russian Federation

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
3-O-13	HE frag (230 g HE)	impact	1.4 kg	220 mm (est)	52 mm	in service	dispensed by artillery projectile
3-O-23	HEAT/frag (42 g HE)	impact	350 g	62.5 mm (closed)	44 mm	in service	DPICM with spring-loaded telescopic body, dispensed by artillery projectile
9N22	Frag (690 fragments)	impact/SD	7.5 kg	540 mm	74 mm	in service	Bomblet used in the 9N18E warhead for FROG-7
9N230/9N235	HE frag (312 g HE)	impact/SD	1.75 kg	263 mm	65 mm	in service	dispensed by artillery rocket. Difference between 9N230 and 9N235 is believed to be fragment size
AOKh-8	HE/frag/ chemical (war gas no 12)	impact	8.0 kg	0.63 m	106 mm	obsolete	chemical fragmentation bomblet
AOKh-10	HE/frag/ chemical (war gas no 12)	impact	9.8 kg	0.61 m	n/k	obsolete	chemical fragmentation bomblet
AOKh-15	HE/frag/ chemical (war gas no 12)	impact	15 kg	0.63 m	107 mm	obsolete	chemical fragmentation bomblet



A range of Russian submunitions, drawn to a common scale and annotated with function and primary dimension (Lyn Haywood) 0074136

Russian Federation (continued)

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
AOKh-25	HE/frag/ chemical (war gas no 12)	impact	23.6 kg	n/k	122 mm	obsolete	chemical fragmentation bomblet
AO-1SCh bomblet	HE frag (Amatol/TNT)	impact	1.2 kg	160 mm	49 mm	in service	fragmentation bomblet carried by RPK-250/275 and 500 cluster bombs
AO-2.5 bomblet	HE frag	impact	2.88 kg	380 mm	69 mm	in service	fragmentation bomblet carried by RPK-250/275 and 500 cluster bombs
AO-2.5 RTM bomblet	HE frag (2 warheads)	impact with short delay	2.5 kg	150 mm	90 mm	in service	fragmentation bomblet carried by RPK-500 AO-2.5
BetAB bomblet	HE penetrator	impact with short delay	25 kg	0.66 m	76 mm	in service	concrete penetrating bomblet option for RBK-500U cluster bomb
MOTIV-3M, F	Misznay Schardin (4.5 kg HE)	IR sensor	14.9 kg	0.28 m	255 × 186 mm	in service	Version of the SPBE-D submunition used in artillery rockets
OAB-2.5RT	HE frag (2 warheads)	impact with short delay	2.5 kg	170 mm	90 mm	in service	fragmentation bomblet option for RPK-500U cluster bomb
ODS-OD	Fuel-air explosive	airburst	50 kg (est)	n/k	n/k	in service	8 parachute-retarded FAE bomblets in a KMGU dispenser
OFAB-50	HE frag/ cratering	impact	50 kg	n/k	n/k	in service	fragmentation/cratering bomblet option for RPK-500U cluster bomb
OKT-1.5 bomblet	incendiary or chemical	impact	1.5 kg	n/k	122 mm	obsolete	spherical shape
Prosab bomblet	(127 g HE)	impact or delay	n/k	0.084 m	64 mm	in service	90 fragmentation/ krea denial bomblet carried by Prosab-250 cluster bomb
PTAB-1M bomblet	HEAT/frag	impact	0.94 kg	0.26 m	42 mm	in service	anti-tank bomblet option for RBK-500U cluster bomb
PTAB-2.5 bomblet	HEAT/frag (0.66 kg RDX/TNT)	impact	2.5 kg	0.36 m	60 mm	in service	anti-armour bomblet carried by RPK-250/275 and 500 cluster bombs
PTAB-2.5M (short tail) bomblet	HEAT/frag (0.45 kg RDX-TNT)	impact	2.5 kg	0.37 m	90 mm	in service	anti-tank bomblet carried by RPK-250/275 and 500 cluster bombs

Some of the submunitions used with the RBK-500U cluster bomb. From the top: OAB-2.5RT, OFAB-50, BETAB and PTAB-1M
(SRPE Bazalt)
0006392

Russian Federation (continued)

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
PTAB-2.5M (long tail) bomblet	HEAT/frag (0.45 kg RDX/TNT)	impact	2.5 kg	0.4 m	90 mm	in service	anti-tank bomblet carried by RPK-250/275 and 500 cluster bombs
ShOAB-0.5 bomblet	HE frag	spin-armed, impact	0.5 kg	n/a	62 mm	in service	copy of US BLU-26 anti-personnel bomblet, carried by RBK-500 ShOAB-0.5 cluster bomb
SPBE bomblet	Misznay Schardin (4.5 kg HE)	IR sensor	15.6 kg	0.29 m	186 mm	in service	anti-tank bomblet carried by RBK-500 SPBE and RBK-500U cluster bombs
SPBE-D SFW bomblet	Misznay Schardin (4.5 kg HE)	IR sensor	14.9 kg	0.28 m	255 × 186 mm	in service	anti-tank bomblet carried by RBK-500 SPBE-D and RBK-500U cluster bombs. Also known as MOTIV-3M or F
ZAB-1E bomblet	incendiary	impact	1.5 kg	0.36 m	65 mm	in service	incendiary bomblet carried by various cluster bombs
ZAB-2.5 bomblet	incendiary (1.72 kg)	impact	2.7 kg	0.14 m	91 mm	in service	incendiary bomblet carried by RPK-250/275 and 500 cluster bombs

Note: For more details see separate entry, *Russian submunitions*. A number of Russian mines can also be deployed from dispensers and munitions.

Serbia

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
KB-1	HEAT/frag with ball bearing fragmentation sleeve	impact	210 g	80 mm	40 mm	in service	DPICM delivered by the 'Orkan' 262 mm MRL
KB-2	HEAT/frag (solid side wall)	impact	210 g	80 mm	40 mm	in service	DPICM delivered by the 'Orkan' 262 mm MRL
KB-PTM	Misznay Schardin, 680 g HE	magnetic influence	1.7 kg	110 mm	100 mm	development cancelled	Anti-vehicle mine developed for 'Orkan' MRL. Reached early stages of production but not fielded
PETAB-1.5 HC	HEAT	impact	1.5 kg	n/k	n/k	in service	Anti-tank bomblet. 54 carried by a KPT-150

The KB-1 DPICM (Colin King) 0074224

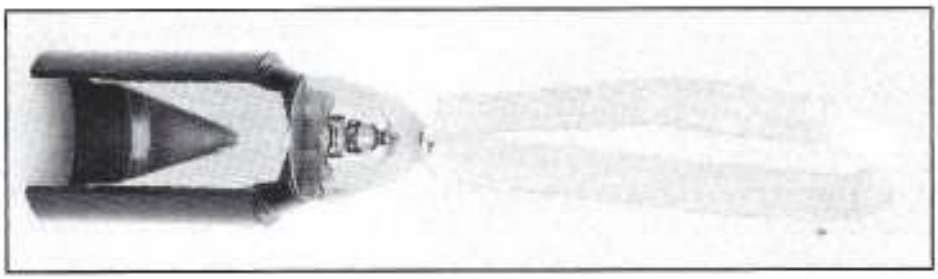
The KB-2 DPICM (Colin King) 1041010

Serbia (continued)

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
PETAB-2.5 HC	HEAT	impact	2.5 kg	n/k	n/k	in service	Anti-tank bomblet
RAB-2.5	n/k	n/k	2.5 kg	n/k	n/k	in service	Fragmentation bomblet. 44 carried by a KPT-150
RAB-3.5	n/k	n/k	3.5 kg	n/k	n/k	in service	Fragmentation bomblet. 34 carried by a KPT-150
RAB-16	n/k	n/k	16 kg	n/k	n/k	in service	Fragmentation bomblet, normally carried in clusters of 8
ZAB-45	n/k	n/k	45 kg	n/k	n/k	in service	Incendiary bomblet

Singapore

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
n/k	HEAT/frag	impact/SD	290 g (est)	85 mm (est)	40 mm (est)	in service	M42-type DPICM delivered by artillery projectile

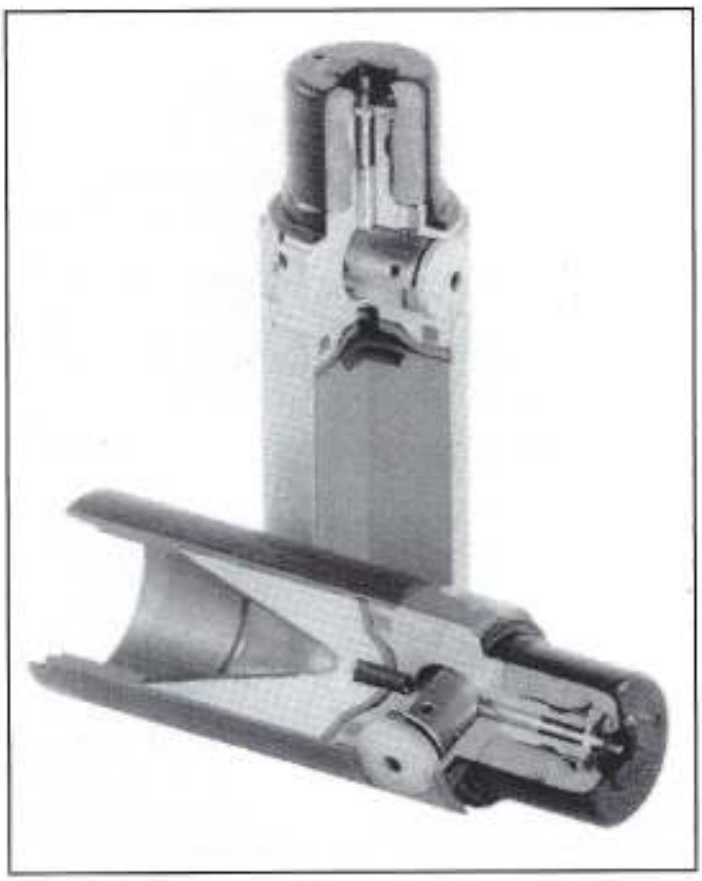


DPICM manufactured in Singapore
0083148

Slovakia

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
AGAT anti-armour bomblet	HEAT/frag	impact	275 g	118 mm	38 mm	in service	SD feature operates 28–32 s after arming
AGAT incendiary bomblet	incendiary	impact	283 g	118 mm	38 mm	in service	burns for 20 s

Note: One AGAT 122 mm rocket contains 50 anti-armour bomblets and six incendiary bomblets.

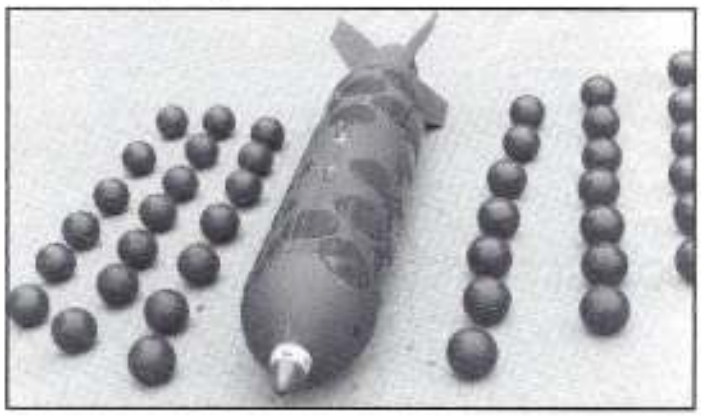


AGAT submunitions: anti-armour (front) and incendiary (behind)
(Technopol)
0546819

South Africa

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
Alpha bomblet	HE frag (1.4 kg RDX/TNT)	impact with 0.65 sec delay	6.2 kg	n/a	140 mm	See Note	Spherical bomblet used in CB 470.
DPICM; unknown designation	HEAT/frag (30 g Composition A5)	impact/SD	290 g (est)	85 mm (est)	40 mm (est)	See Note	DPICM with self-destruct feature. Delivered by artillery projectile

Note: No longer in production. Banned and due for destruction under the terms of the 2008 Cluster Munitions Convention (CCM).

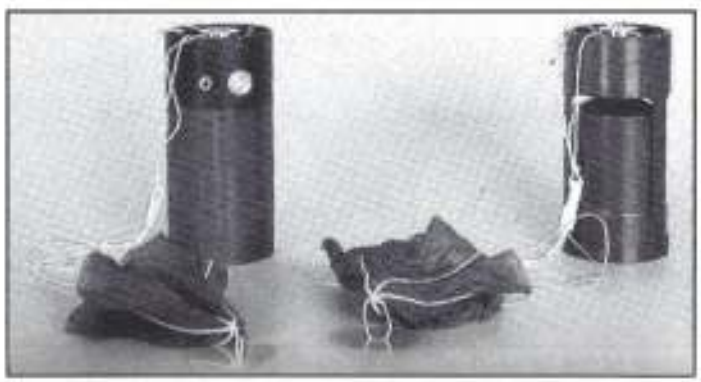


South African CB 470 cluster bomb and its load of 40 Alpha bomblets
(T J Gander)
0504562

Spain

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
ABL-250 bomblet	HEAT/frag	impact	0.6 kg	370 mm	55 mm	See Note	Anti-armour/anti-personnel bomblet carried by ABL-250 cluster bomb. Similar to Chilean PM-1
CH bomblet	HEAT	impact	0.8 kg	130 mm	55 mm	See Note	Anti-armour bomblet; 180 carried by BME 330 C cluster bomb
CP bomblet	HE frag	impact	0.8 kg	130 mm	55 mm	See Note	Fragmentation bomblet; 180 carried by BME 330 C cluster bomb
MAC-2 mine	HE frag	pressure/anti-disturbance/ self-destruct	3.5 kg	116 mm	116 mm	See Note	Anti-tank mine carried by BME 330 AT cluster bomb
SAP bomblet	2-stage: shaped charge and cratering charge	impact	18 kg	530 mm	130 mm	Status uncertain	Anti-runway/penetrating bomblet carried by BME 330 AR cluster bomb
SAC-1 bomblet	HEAT/frag	impact	0.2 kg	103 mm	44 mm	See Note	Anti-tank bomblet carried by BME 330 AT cluster bomb
SNA bomblet	HE fragmentation incendiary	variable delay/anti-disturbance	0.82 kg	130 mm	60 mm	See Note	Area denial bomblet; 180 carried by BME 330 AR and BME 330 C cluster bombs

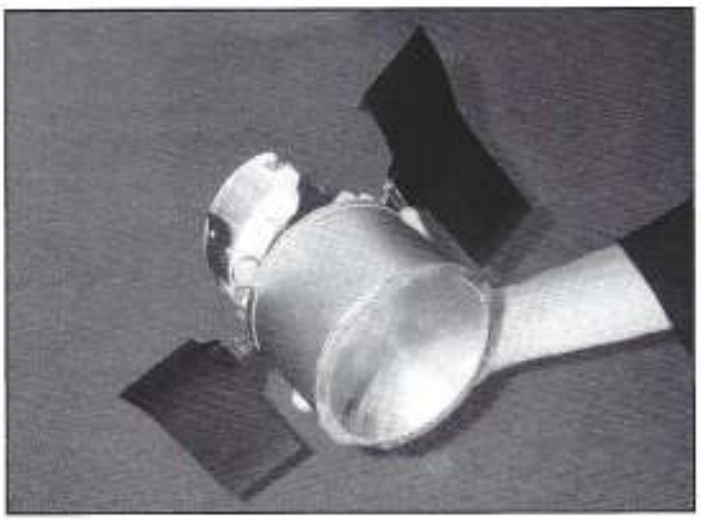
Note: No longer in production. Banned and due for destruction under the terms of the 2008 Cluster Munitions Convention (CCM).



Spanish SNA area denial bomblet (left) and CP or CH bomblet (right)
0604587

Sweden

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
BONUS	MS with Tantalum plate	IR scanning	6.5 kg	82 mm	138 mm	in service	incorporates a self-destruct back-up which functions on impact

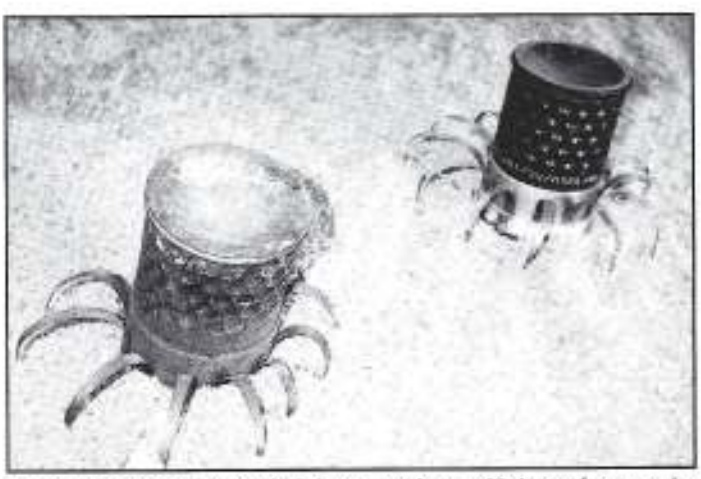


An inert BONUS submunition (Colin King)
1041011

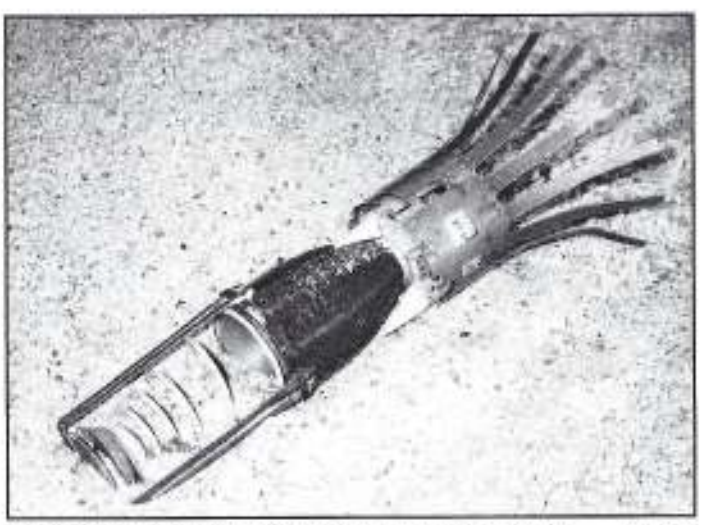
United Kingdom

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
BL 755 Advanced Anti-Armour (AAA) bomblet	HEAT/frag	impact	0.9 kg	150 mm closed 0.63 m extended	68 mm	See Note	Parachute-retarded dual-purpose bomblet carried by BL 755 Mk 2 cluster bomb. Used in Iraq
BL 755 GP bomblet	HEAT/frag	impact	0.9 kg	150 mm closed 0.36 m extended	72 mm	See Note	Dual purpose bomblet carried by BL 755 Mk 1 cluster bomb. Used in the Falklands, Gulf and Balkans
HB-876 mine	Misznay Schardin/ frag	variable delay/anti-disturbance/ self-destruct	2.4 kg	150 mm stowed	100 mm stowed	withdrawn from UK service around 1998	Area denial mine, formerly carried by HADES cluster bomb and JP 233
M85	HEAT/frag (44 g RDX)	impact, with SD after 15 s	296 g	85 mm	42 mm	See Note	Israeli bomblet used in the British L20A1 155 mm projectile
SG 357 bomblet	2-stage warhead: shaped charge and cratering charge	impact	26 kg	890 mm	106–180 mm	withdrawn from UK service around 1998	Concrete penetrating submunition carried by JP 233

Note: No longer in production. Banned and due for destruction under the terms of the 2008 Cluster Munitions Convention (CCM).



British HB 876 bomblets, which have now been withdrawn from service (Colin King, courtesy of DEODS) 0074676



British BL 755 GP bomblet (Colin King, courtesy of DEODS) 0074676

United States

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
BAT	Tandem HEAT ad frag	acoustic and IR	20 kg	914 mm	140 mm	in service	Can be dispensed by bomb, MLRS or missile
BLU-3/B 'Pineapple'	HE frag (160 g HE and 250 steel pellets)	impact	0.70 kg	170 mm (open)	63 mm	obsolete	Anti-materiel bomblet. An SUU-7/A filled with 360 BLU-3/Bs was designated CBU-2/A. An SUU-14 series with 144 BLU-3/Bs was designated CBU-14 series. Also used in CBU-27 series
BLU-4 series	HE frag	impact	0.58 kg	n/k	n/k	obsolete	Anti-personnel bomblet. An SUU-7/A filled with 508 BLU-4s was designated CBU-1/A
BLU-7 series	HEAT/frag	impact	0.64 kg	n/k	n/k	obsolete	Anti-tank/anti-materiel bomblet. An SUU-10/A filled with 371 BLU-7/Bs was designated a CBU-3 series
BLU-16/B	smoke	impact	0.72 kg	n/k	n/k	obsolete	Smoke bomblet derived from an M8 grenade. An SUU-7B/A filled with 213 BLU-16/Bs was designated CBU-11/A
BLU-17/B	white phosphorus	impact	0.50 kg	n/k	n/k	in service	Smoke bomblet derived from an M15 grenade. An SUU-7 series filled with 213 BLU-17/Bs is designated CBU-12 series
BLU-18/B	HE frag	impact	0.20 kg	n/k	n/k	obsolete	Anti-personnel bomblet. An SUU-13/A filled with 1,200 BLU-18/Bs was designated CBU-7 series
BLU-19/B23	HE and GB (Sarin) nerve gas	impact	n/k	n/k	n/k	obsolete	Chemical bomblet, used in an SUU-31/A dispenser to form a CBU-15/A
BLU-20/B23	thermally dispersed BZ gas	impact	n/k	n/k	n/k	obsolete	Chemical bomblet
BLU-21/45	dry biological agent	impact	n/k	n/k	n/k	obsolete	Biological agent bomblet
BLU-22/45	wet biological agent	impact	n/k	n/k	n/k	obsolete	Biological agent bomblet
BLU-24 series 'Orange'	HE and steel fragments	impact	0.54 kg	n/a	69 mm	obsolete	Anti-personnel bomblet. An SUU-14/A filled with BLU-24/Bs was designated CBU-24/A. 132 in a SUU-14 was designated CBU-25. 264 in a SUU-50/A was designated CBU-60/A
BLU-25/B	HE frag	impact	0.20 kg	n/k	n/k	obsolete	Anti-personnel bomblet, an SUU-45/A filled with BLU-25/Bs was designated CBU-18/A

US submunitions used extensively in Southeast Asia include (from the top left, clockwise): BLU-3/B, BLU-61/B, BLU-42/B, BLU-26/B and BLU-66/B (Colin King) 0074677

BLU-43/B 'Dragon's Tooth' anti-personnel mines (Colin King) 0074617

United States (continued)

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
BLU-26/B 'Guava'	HE frag	impact or short delay	0.54 kg	n/a	62 mm	in service	Anti-personnel bomblet, an SUU-30 series containing 665 BLU-26/B was designated CBU-24 series
BLU-28/B	self-dispersing biological agent	impact	n/k	n/k	n/k	obsolete	Biological agent bomblet
BLU-29/B	HE frag	impact	72.6 kg	n/k	n/k	in service	Anti-personnel and anti-matériel bomblet
BLU-30	dry chemical agent	impact	n/k	n/k	n/k	obsolete	Chemical bomblet
BLU-36/B	HE frag	variable delay	0.43 kg	n/k	n/k	obsolete	Delay-fuzed BLU-26/B. Area denial, anti-personnel and anti-matériel bomblet. An SUU-30 series containing 670 BLU-36/B was designated CBU-29 series
BLU-39/B	CS gas bomblet	impact	0.08 kg	n/k	n/k	obsolete	Chemical bomblet 16 × 33 in a CBU-19 and 40 × 30 in a CBU-30
BLU-40/B	HE frag	variable delay	0.77 kg	n/k	n/k	in service	Area denial, anti-personnel and anti-matériel bomblet
BLU-41/B	HE frag (0.13 kg HE)	n/k	n/k	n/k	n/k	obsolete	Fragmentation mine
BLU-42 series	HE frag (0.13 kg HE)	multiple tripwires and self-destruct	n/k	n/a	72 mm	withdrawn	Similar to BLU-41/B but with trip wires. 540 BLU-42/B contained in a SUU-38/B were designated CBU-34
BLU-43 series 'Short Dragon's Tooth'	HE blast	pressure	n/k	n/k	n/k	withdrawn	Scatterable anti-personnel mine. An SUU-13/A containing 4,800 BLU-43/B was designated CBU-28/B
BLU-44 series 'Long Dragon's Tooth'	HE blast	pressure	n/k	75 mm	45 mm	withdrawn	Scatterable anti-personnel mine. An SUU-13/A containing 4,800 BLU-44/B was designated CBU-37/A
BLU-45/B	HE shaped charge	impact and self-destruct	n/k	n/k	n/k	withdrawn	Anti-tank mine. An SUU-36/A containing 30 BLU-45/B was designated CBU-33/A
BLU-48/B	HE frag	impact	n/k	n/k	n/k	obsolete	Anti-personnel bomblet. 2,030 BLU-48/B carried in the SUU-37/A were designated CBU-43/A. Also used in CBU-44/A
BLU-49/B	HE frag	impact	6.10 kg	n/k	n/k	in service	Anti-personnel bomblet, 40 used in a CBU-38/A

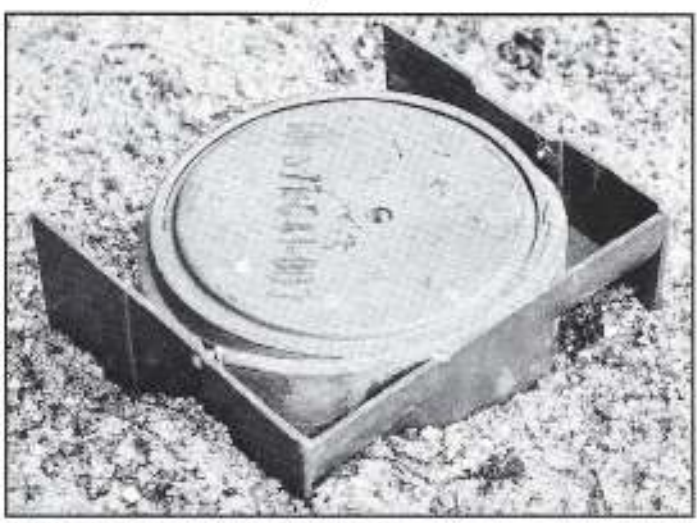
An unexploded BLU-97/B bomblet in Kosovo (Colin King) 0074878

BLU-114 looks similar to BLU-97, but dispenses carbon fibres to disrupt electrical supplies (JDW) 0062829

United States (continued)

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
BLU-54/B	HE frag (0.13 kg HE)	multiple tripwires and long delay self-destruct	n/k	n/k	n/k	withdrawn	Similar to BLU-42/B, but with different fuze system. 540 BLU-54/B in an SUU-38/A were designated CBU-42/A
BLU-55/B	HE frag	n/k	n/k	n/k	n/k	obsolete	Anti-personnel mine. Carried in an SUU-13/A and designated CBU-47/A
BLU-59/B	HE frag	variable delay	0.43 kg	n/k	n/k	obsolete	Anti-personnel fragmentation bomblet. 670 BLU-59/B carried in a SUU-30 series were designated CBU-49
BLU-60/B	HE frag	impact	6 kg	n/k	n/k	obsolete	Fragmentation bomblet. 50 BLU-60/B carried in a SUU-13/A were designated CBU-50/A
BLU-61A/B	HE frag/ incendiary	impact	1 kg	n/a	105 mm	in service	Fragmentation/incendiary bomblet. 217 BLU-61/B carried in a SUU-30B/B are designated CBU-52 series. Formerly used in SUU-54 series as CBU-76/B and CBU-79/B
BLU-62/B	HE frag	impact	0.43 kg	n/k	n/k	in service	Anti-personnel and anti-materiel bomblet
BLU-63/B	HE frag	impact	0.43 kg	n/a	62 mm	in service	1,860 BLU-63/B carried in an SUU-54/B are designated CBU-75/B. May be mixed with BLU-86/B in CBU-75A/B
BLU-66 series 'Pineapple'	HE and 260 steel fragments	impact	0.50 kg	n/a	69 mm	in service	Anti-personnel bomblet. An SUU-7C/A filled with 444 BLU-66 series is designated CBU-46 series
BLU-67/B	Cratering charge	impact	5 kg	n/k	n/k	obsolete	Anti-runway bomblet. 40 BLU-67/B carried in a SUU-13/A were designated CBU-51/A
BLU-68/B	HE frag/ incendiary	impact	0.42 kg	n/k	n/k	obsolete	Anti-personnel and anti-matériel bomblet. BLU-68/Bs carried in a SUU-30B/B were designated CBU-54/B
BLU-69/B	incendiary	impact	0.73 kg	n/k	n/k	obsolete	Anti-personnel bomblet, an SUU-14A/A filled with 132 BLU-69/Bs was designated CBU-57/B
BLU-70/B	incendiary	impact	0.40 kg	n/k	n/k	obsolete	Anti-personnel bomblet. 670 BLU-70/B carried in a SUU-30B/B were designated CBU-53/B

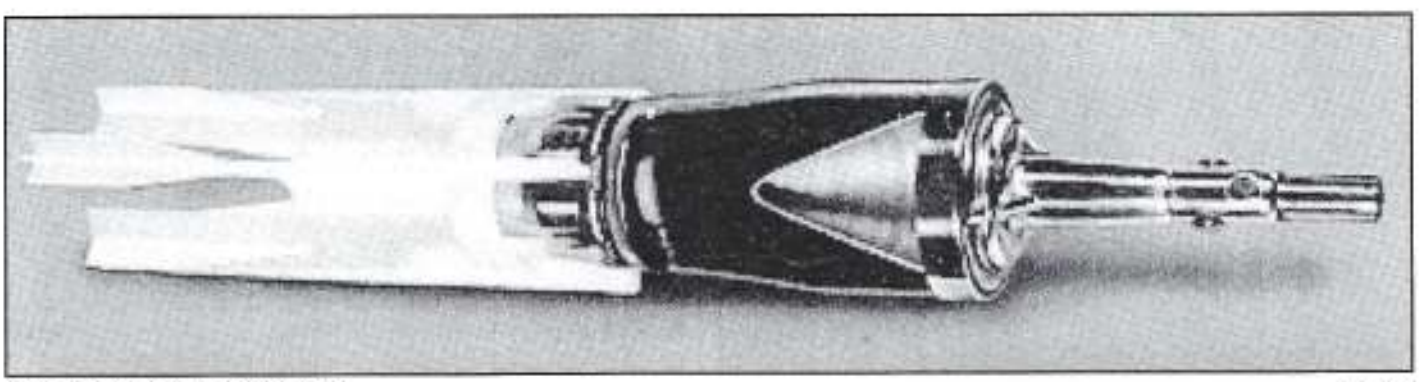
The M73 'Hydra' (Colin King)
1121134



BLU-91/B 'Gator' anti-tank mine (Colin King) 0074605

United States (continued)

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
BLU-73/B	Fuel-air blast (35 kg ethylene oxide)	impact (using nose probe)	45 kg	0.53 m	340 mm	in service	Three BLU-73/B in an SUU-49/B are designated CBU-55/B. Also used in CBU-72
BLU-77/B	HEAT/frag	impact	0.35 kg	n/k	n/k	in service	Anti-tank bomblet, with a secondary anti-personnel function. 717 BLU-77/B carried in a Mk 7 Mod 3 are designated CBU-59/B
BLU-86 series	HE frag	variable delay	0.42 kg	n/k	n/k	in service	Delay-fuzed BLU-63 anti-personnel bomblet. 650 BLU-86/B carried in a SUU-30H/B are designated CBU-71
BLU-91/B 'Gator' mine	2 × Misznay Schardin	magnetic influence/ anti-disturbance	1.68 kg	66 mm deep	146 × 141 mm	in service	Anti-tank mine carried in CBU-78/B, CBU-89/B and CBU-104/B cluster bombs
BLU-92/B 'Gator' mine	HE frag	multiple tripwires	1.95 kg	66 mm deep	146 × 141 mm	in service	Area denial mine with tripwires. Carried in CBU-78/B, CBU-89/B and CBU-104/B cluster bombs
BLU-97/B and BLU-97A/B	HEAT/frag/ incendiary (270 g 70/30 Cyclotol and Zirconium)	impact with secondary all-ways acting	1.5 kg	0.17 m stowed 0.36 m extended	64 mm	in service	Multipurpose bomblet carried by CBU-87/B CEM and AGM-154 JSOW (baseline). 202 BLU-97A/B carried in the WCMD are designated CBU-103/B
BLU-108/B bomblet	4 × Misznay Schardin 'skeet' warheads	IR sensor	n/k	0.88 m stowed	120 mm	in service	Anti-tank submunition carried by CBU-97/B SFW and AGM-154 JSOW/BLU-108/B. 10 BLU-108/B carried in a WCMD are designated CBU-105/B
BLU-114	Expelling charge and 147 carbon wire spools	n/k	1.5 kg (est)	170 mm	65 mm	in service	Similar appearance to BLU-97
Mk 118 'Rockeye'	HEAT/frag (0.18 kg HE)	impact	0.61 kg	0.32 m	48 mm	in service	Anti-armour bomblet carried by Mk 6/7 'Rockeye' dispenser
ISCB-1 mine	HE frag (0.18 kg HE)	impact or variable delay up to 72 hrs	0.52 kg	0.32 m	53 mm	in service	Fragmentation mine carried by the ISCB-1 cluster bomb
M42	HEAT/frag (30 g HE)	impact	210 g	80 mm	40 mm	in service	Artillery-dispensed DPICM
M43	HEAT/frag (30 g HE)	impact	210 g	80 mm	40 mm	obsolete	Artillery-dispensed DPICM
M46	HEAT/frag (30 g HE)	impact	210 g	80 mm	40 mm	in service	Artillery-dispensed DPICM
M73 'Hydra'	HEAT/frag	M230 fuze: impact (all-ways acting)	544 g	69 mm	64 mm	in service	Dispensed by Hydra rockets



Sectioned Mk 118 'Rockeye' bomblet

0061965

United States (continued)

Designation	Warhead	Fuzing	Weight	Length	Body diameter	Status	Remarks
M77	HEAT/frag (30 g HE)	impact	213 g	80 mm	40 mm	in service	Artillery-dispensed DPICM
M80	HEAT/frag (16 g HE)	impact/SD	180 g (est)	70 mm (est)	31 mm (est)	in service	Artillery-dispensed DPICM
M125	1.18 kg of Sarin nerve gas	impact	n/k	n/k	n/k	obsolete	Chemical bomblet
SADARM	MS (1.5 kg HE, Tantalum plate)	IR scanning	11.8 kg	204 mm	147 mm	in service	Dispensed by MLRS artillery rocket or 155 mm projectile
XM41E1 'Gravel mine'	HE blast (9.4 g RDX/ Lead Azide)	pressure	12 g approx	70 mm	n/a	obsolete	Carried in SUU-41B/A and designated CBU-39/A
XM40E5 'Gravel mine'	HE blast (0.54 g Chlorate/ Phosphorus based)	pressure	3 g approx	45 mm	n/a	obsolete	Carried in SUU-41B/A and designated CBU-40/A

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